AD-A213 937

Presentations at

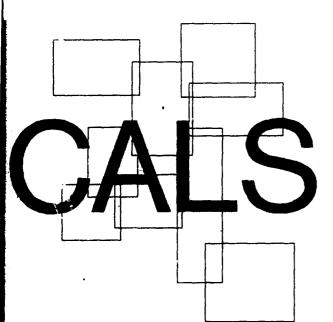
CALS CONFERENCE

COMPUTER-AIDED ACQUISITION

AND LOGISTIC SUPPORT

CALS Phase I.2 Conference





A DoD / Industry / NIST Conference

Held at Three Locations

- Philadelphia, Pennsylvania20 April 1989
- Anaheim, California 27 April 1989
- Gaithersburg, Maryland 2 May 1989

United States Department of CommerceNational Institute of Standards and Technology

NIST 89 10 25 017

PRESENTATION MATERIAL

Computer-aided Acquisition and Logistics Support (CALS)

Phase I.2 Conferences

NCGA '89, 20 April 1989 Philadelphia, Pennsylvania

FCC/DGC West, 27 April 1989 Anaheim, California

> NIST, 2 May 1989 Gaithersburg, Maryland

A DOD/INDUSTRY/NIST CONFERENCE

CONTENTS

Introduction
CALS Points of Contact
CALS Bulletin Board System 5
Agenda
Biographical Sketches of Speakers 9
Presentations:
Government Perspective
DoD Initiatives in Computer-aided Acquisition and Logistics Support - Dr. Michael McGrath
Service Update
Computer-aided Acquisition and Logistic Support (CALS) Mr. Alfredo Campo
Department of the Air Force Computer Aided Logistics & Acquisition Support - Mr. Oscar Goldfarb
Industry Perspective
CALS Industry Steering Group - Mr. Harold Stormfeltz
Concurrent Engineering
Concurrent Engineering - Col. Larry D. Griffin
PDES, Inc
Product Data Exchange Specification (PDES) Mr. Robert Kiggins
PDES National Testbed
National PDES Testbed - Ms. Cita Furlani
CALS Standards - Phase I.2
1989 CALS Standards - Phase I.2 - Mr. Bruce Lepisto
Distribution/
Analahan
i Availability Codes APPROVED FOR PUBLIC DELEASE DISTRIBUTION Avail and/or
APPROVED FOR PUBLIC RELEASE DISTRIBUTION Dist

IS UNLIMITED per DASD(S)CALS(Mr. Lepisto 697-0051) TELECON 30 Oct 89 CB

Paperless Technical Manuals
Joint DoD/Industry CALS Pageless Technical Manual Study Ms. Mary Anne Thompson
Automated Interchange of Technical Information (MIL-STD-1840A)
The Development of MIL-STD-1840A and Other CALS Standards Mr. David S. Bettwy
Electronic Publishing
Update on MIL-M-28001 and Joint Service LSAR ADP Revisions Ms. Pam Gennusa
Logistic Support Analysis Record (MIL-STD-1388-2B)
MIL-STD-1388-2B and Joint Service LSAR ADP Revisions Mr. George Desiderio
CALS Test Network
CALS Test Network: Verification and Application Testing Strategy - Mr. Mel Lammers
IGES Validation
CALS Phase I.2 "IGES Validation" - Mr. David Remington
Special Concurrent Session:
Competitive Gateway to DoD Contracting - Mr. Bruce Lepisto
List of Registrants

INTRODUCTION

The CALS Phase I.2 Conference was held in conjunction with the National Computer Graphics Association's NCGA Integrate '89 in Philadelphia, Pennsylvania, on 20 April 1989; at the Federal Computer Conference and Defense & Government Computer Graphics Conference FCC/DGC West in Anaheim, California, on 27 April 1989; and at the National Institute of Standards and Technology (NIST) on 2 May 1989.

Computer-aided Acquisition and Logistic Support (CALS) is a DOD and Industry initiative. CALS addresses the integration and use of automated digital technical information for weapon system design, manufacture, and support.

CALS focusses on the generation, access, maintenance, and distribution of the technical data associated with weapon systems. This includes engineering drawings, product definition and logistic support analysis data, technical manuals, training materials, technical plans and reports, and operational feedback data. The CALS program will facilitate data exchange and access, and reduce the duplication of the data preparation effort. CALS provides both the initiative and the framework to integrate the existing islands of automation within DOD and Industry.

Closely tied to the successful implementation of the digital technologies is the timely and successful development and application of related standards. A CALS objective is to facilitate the digital transfer of logistic and technical data between industry and government by leveraging existing international and national standards and accelerating the development of new standards to support future requirements. Supporting the application of commercial standards are specific military standards, specifications, and a handbook prepared by DOD and coordinated among Industry, DOD, and other government agencies.

This CALS Phase I.2 Conference provided an update on the DOD and Industry activities for 1989, covered in detail the standards and specification efforts scheduled for the year, and provided details of CALS and CALS related efforts such as PDES Inc., the PDES National Testbed, paperless technical manuals, the CALS Test Network, IGES validation, and the DOD Concurrent Engineering Initiative.

These proceedings contain the visuals for the material presented at the conference, the speaker's biographical sketches, and the list of registrants.

DOD CALS POINTS OF CONTACT

OSD	CALS POLICY OFFICE & CALS SUPPORT OFFICE	Michael McGrath Bruce Lepisto Joseph Arcieri William Gorham Susan O'Neal James Dalgety Donald Hall Lt. Marion Fedorshak	(703) (703) (202) (703) (703)	697-0051 756-8420 756-8420
WORKING O	POTTP S	Lt. Marion redorsmak	(202)	697-0051
PLANNIN		Michael McGrath Steering Grp Reps	(202)	697-0051
IMPLEME	ENTATION	Bruce Lepisto Service/Agency POC's	(202)	697-0051
SPECS 6	STANDARDS	James Dalgety Ernest Thorne	(703) (703)	
	ICATIONS SERS GROUP	Jack Bartley Gary Denman Gerald Shumaker	(202)	695-9505 255-3724
ARMY NAVY AIR FORCE DLA NIST (Tech	AMC NAVSUP AFSC DRDO Advisors)	Mike DuCody Dave Kyle LTC Joseph Chase Walt Simonson Roy Morgan David Bettwy	(301) (703)	694-9111 981-3915 274-4210 975-3254

DOD CALS STEERING GROUP

	PRINCIPAL	ALTERNATES
CHAIRMAN	Russell R. Shorey	Michael F. McGrath
COMMITTEE EXECUTIVE	Joseph Arcieri	
ARMY	Eric Orsini	Alfred Campo Ron Truesdell GEN William Pagonis MGEN Leon Salomon COL Edward Wills
NAVY	RADM Guy Curtis	Paul Cataldo
AIR FORCE	Lloyd Mosemann	MGEN Edward Bracken Oscar Goldfarb
DLA	Thomas Knapp	Walt Simonson
DCA	Herbert Goertzel	
DARPA	William Bandy	
SDIO	COL Kenneth Collins	
OSD DASD(L)	John Mittino	
DASD (P)	Eleanor Spector	Al Volkman
DASD (S) SP	Ron Oxley	
DASD(S)IS	James Miller	Jack Bartley
DASD (TQM) SDM	Peter Yurcisin	Carl Berry
OASD (C) IRM	Cynthia Kendell	Bel Leong-Hong
OASD (C ³ I) IS	Diane Fountaine	
NIST (Tech Advisor)	David Jefferson	

INDUSTRY CALS TASK FORCE

CHAIRMAN: CHIEF OPERATIN COMMITTEE EXEC ADVISOR:	G OFF: MR. HAROLD	NGUEMARE, Westinghouse STORMFELTZ, Northrop DWELL, NSIA VIS, Pymatuning	(213)	332-1404
Ms. Naomi M Mr. Joe M er	edith, Newport News	Electric Company	(703)	765-3400 892-4470 753-1473
Mr. Howard Mr. Ralph C		International	(213)	414-1841 812-6005 424-3529
Mr. Stanley	ATION EXCHANGE TASK Meyers, Grumman Da chersky, E-Systems			682-8552 661-1000
Mr. David I			(408)	234-7040 289-2442 935-5736
Dr. Bob Ful	PUBLIC COMMUNICATIO ton, Georgia Tech clowski, Dynamic Re			894-7409 475-9090
	TASK GROUP wlings, Prime Compu n Tilton, General E			275-1800 594-5492
	TASK GROUP lliland, ELS yers, Grumman			553-7332 682-8552
STRATEGIC PLAN Mr. Perley Mr. Dick Su			(703) (301)	968-1865 765-1875
AIA MI EIA MI ICA MI NCGA MI NSIA MI SAE MI	AISON . Herbert Atkins . Joe Dauksys . Edward Nucci . Al Frager . Robert Willis . Lon Caldwell . David Bentley . Claude Farinha		(202) (202) (703) (703)	

CALS BULLETIN BOARD

(301) 921-9842 OR (301) 948-7438
AVAILABLE 24 HOURS A DAY, 7 DAYS A WEEK
For the Exchange of Information Related to the CALS Program

- 1. The CALS Electronic Bulletin Board is operated for DOD and the Industry CALS Task Force by the CALS Program Support Office at the National Institute of Standards and Technology. Through it, users can identify key points of contact, upcoming meetings, and other bulletin boards of interest to the CALS community. Selected CALS documents, such as MIL-STD-1840A, can be downloaded in a variety of formats. Questions or comments can be sent to the system operator or other users.
- 2. You need only a standard ASCII terminal or computer to use the CALS bulletin board system. Set your terminal or computer to:
 - 300, 1200, or 2400 baud
 - 8 or 7 data bits
 - Even or no parity
 - 1 stop bit
- 3. Dial (301) 921-9842 or (301) 948-7438. After carrier detection there will be a pause by the system to identify your communication baud rate. Once the system has identified the baud rate at which you are communicating, it will guide you through the bulletin board by asking key questions and providing helpful menus. (You assign your own password at the initial session. In subsequent sessions only your first name, last name, and password are required to gain access to the Bulletin Board.)
- 4. The CALS Electronic Bulletin Board is used for:
 - o Electronic messaging system for the CALS community.
 - o Electronic file transfer, including downloading of the CALS standards.
 - o Bulletins for meetings, conferences, workshops, and other timely news.
 - o Key points of contact (including other specialized BBS's) in the CALS community. Note: A separate, dedicated BBS is being established to support the CALS distributed testbed.
 - o Other on-line CALS and standards-related information.
- 5. If you have a question or a problem, please call the voice line at (301) 975-6641 and ask for Dave Bettwy.

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

(CALS) PHASE I.2 CONFERENCE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY 2 MAY 1989

AGENDA

0745	REGISTRATION
0830	Introduction
0840	Government Perspective Dr. Michael McGrath, Director DOD CALS Office, OASD
0910	Mr. Alfredo Campo, OAS, Army Assistant Deputy for Logistics Radm Guy Curtis, USN, Assistant DCNO, Logistics Mr. Oscar Goldfarb, OAS, Air Force, Deputy for Supply Maintenance and Logistics Plans Dr. Walter Simonson, DLA, Chief of Research Development Office
1000	Coffee Break
1030	Industry Perspective Mr. Harold Stormfeltz, Vice Chairman Industry Steering Group, Northrop
1050	Industry Panel Industry Steering Groups' Technology Area Task Groups
1130	Concurrent Engineering Col. Larry D. Griffin, Deputy Director, Weapon Support Improvement Group, OASD (Production & Logistics)
1200	PDES, Inc. Mr. Robert Kiggins, General Manager, PDES, Inc.
1230	PDES National Testbed Ms. Cita Furlani, Leader PDES Test Bed Group National Institute of Standards & Technology

1300	LUNCH
1400	CALS Standards - Phase I.2 Mr. Bruce Lepisto, Deputy Director, DOD CALS Office, OASD (Production & Logistics)
1420	Paperless Technical Manuals Ms. Mary Anne Thompson Digital Information Exchange Task Group: Technical Manuals, TRW, Inc.
1440	Automated Interchange of Technical Information (MIL-STD-1840A) Mr. David S. Bettwy, Deputy Chief Automated Production Technology Division National Institute of Standards & Technology
1500	Electronic Publishing (MIL-M-28001A) Ms. Pam Gennusa, Director Product Marketing Datalogics
1520	Logistic Support Analysis Record (MIL-STD-1388-2B) Mr. George Desiderio, OASD, Weapon Support Improvement Group
1540	CALS Test Network Mr. Mel Lammers, CTN Program Manager Air Force Logistics Command
1600	IGES Validation Mr. David Remington, Chairman, IGES/PDES Verification Testing Methodology Committee

BIOGRAPHICAL SKETCHES OF SPEAKERS CALS PHASE I.2 CONFERENCE JOINT DOD/INDUSTRY/NIST 2 MAY 1989

David S. Bettwy Automated Production Technology Division National Institute of Standards and Technology

Mr. Bettwy is Deputy Chief of the Automated Production Technology Division at the National Institute of Standards and Technology (NIST) formerly the National Bureau of Standards. Mr. Bettwy has a BSME degree from George Washington University, has been with NIST for 11 years, and previously was with the Harry Diamond Laboratories (HDL) of the Army Materiel Command for 25 years. Mr. Bettwy's experience in DoD and DoC includes responsibility for electromechanical R&D in the area of ordnance devices, configuration management of corporate technical data package repositories, management of manufacturing facilities, and acquisition of production quantities of electronic fuzes for ordnance applications. At NIST he was involved with the planning and installation of the Center for Manufacturing Engineering's Automated Manufacturing Research Facility. Mr. Bettwy is currently involved with the NIST technical support of the DoD Computer-aided Acquisition and Logistic Support (CALS) program.

Alfredo Campo OAS ARMY (I£L) The Pentagon

As the Deputy to the Deputy Assistant Secretary of the Army for Logistics, maintains detailed cognizance over the total spectrum of Logistics Programs to include Supply, Maintenance, Transportation, Services, Logistics Systems and Physical Security.

Mr. Campo received his PHB (Psychology) from the University of Detroit in 1966 and his MPA (Government) from the George Washington University in 1985. He also has completed many other technical and managerial programs including National Security Management Program (National Defense University); Executive Leadership and Management Program (Federal Executive Institute); and Executive Program for Senior Defense Managers (J.F. Kennedy School of Government, Harvard University).

Mr. Campo's professional experience includes various logistics and data processing assignments in Detroit, St. Louis, and Ft. Monmouth, NJ from 1965-1977; Branch Chief, Log Systems Division Office, Deputy Chief of Staff for Logistics, HQ, DA from 1977-1980; Assistant for Logistics Systems OASA (IL&FM) from

1980-1984; and Assistant Deputy for Logistics OASA(I&L) from 1984 - Present.

Rear Admiral Guy H. Curtis, III US Navy The Pentagon

Rear Admiral Guy Haladane Curtis, III is currently assigned as the Assistant Deputy Chief of Naval Operations (Logistics).

After graduation from the U.S. Naval Academy and commissioning in 1959, Ensign Curtis served for two years on the aircraft carrier USS INDEPENDENCE (CVA 62) and then entered Submarine School. Upon graduation from Submarine School and completion of nuclear power training, LTJG Curtis reported to the Blue Crew of the USS ETHAN ALLEN (SSN 608), the first submarine to be designed and built as a Fleet Ballistic Missile Submarine. In May 1965 he was assigned to the Nuclear Power Training Unit in West Milton, New York, as Engineer Officer of the S3G Prototype where he trained nuclear power plant operators for the Fleet and tested advanced nuclear power plant designs.

From June 1968 to July 1975, Commander Curtis served aboard three nuclear attack submarines, USS STURGEON (SSN 637), USS DACE (SSN 607) and USS WIIALE (SSN 638), where he served as Commanding Officer. In July 1975 Commander Curtis reported for duty as Chief Staff Officer and Training Officer of the Submarine Squadron in La Maddalena, Sardinia. Following a two-year tour there, Captain Curtis reported to Washington, DC, for a three-year assignment as Executive Assistant to the Deputy Chief of Naval Operations (Submarine Warfare).

In May 1980 Captain Curtis assumed command of Submarine Squadron FOURTEEN the nation's first strategic nuclear submarine squadron, in Holy Loch, Scotland. Upon completion of this tour, Captain Curtis served as Chief of Staff for the Commander, Submarine Force, U.S. Atlantic Fleet in Norfolk, Virginia, from August 1981 to July 1983. He was selected for Commodore during this tour.

Commodore Curtis then reported to the Chief of Naval Operations in Washington, DC, as Director of the Strategic Submarine Division (OP-21). Following this, he served as the Program Manager of the SEAWOLF (SSN 21) class submarine Acquisition Program (PMS 350) in the Naval Sea Systems Command from November 1983 to September 1988. He supervised the design and acquisition process of this revolutionary submarine, the first of a new class leading the Navy into the 21st Century. During this tour, the grade of Commodore was changed to Rear Admiral (Lower Half). He was selected for promotion to Rear Admiral (Upper Half) in November 1986.

George Desiderio Defense Systems & Program Office

Mr. George Desiderio is assigned as a general engineer to the DoD Defense Systems and Program Office (DSPO). Mr. Desiderio is responsible to the OASD(P&L) staff for coordinating policy development for Integrated Logistic Support (ILS) and Logistic Support Analysis (LSA). His current projects involve standardization efforts for Level of Repair Analysis, Reliability Centered Maintenance, Military Training Programs, the revision to MIL-STD-1388-2A, and establishment of interfaces between LSAR and other ILS elements. Mr. Desiderio has over 15 years experience in military operations, supply and maintenance, and acquisition logistics. Prior to his assignment at DSPO, he served on active duty as a commissioned officer in the U.S. Army and then as the LSA program administrator at USAF Electronic Systems Division, Hanscom AFB, Massachusetts. His military experience includes assignments at various operational and staff levels in both combat and combat service support units in Europe and the United States. A major in the U.S. Army Reserve, Mr. Desiderio holds a bachelor of science degree in engineering from the U.S. Military Academy, West Point, New York, and a Master of Science degree in Engineering from Northeastern University.

Cita M. Furlani Center for Manufacturing Engineering National Institute of Standards and Technology

Cita M. Furlani is the project manager for the National Product Data Exchange Specification (PDES) Testbed at the National Institute of Standards and Technology (NIST). The Testbed utilizes the Automated Manufacturing Research Facility (AMRF) of NIST. Ms. Furlani participated in the design of the AMRF from the beginning of the project in 1981 with particular responsibility for the material handling system and the data administration system. Related experience at Harry Diamond Laboratories, U.S. Army. M.S. in Computer and Electronic Engineering, George Mason University. B. A. in Physics and Mathematics, Texas Christian University.

Pam Gennusa Datalogics

Pam Gennusa is Director of Marketing at Datalogics, where she has been for the past five years. During that time, Pam served as Program Manager on their contract for the Air Force's Automated Technical Order System (ATOS) project. She moved into the marketing side of the business and began their Product Marketing Group in 1987, beginning with products focused on technical documentation and SGML support. Pam is active on both

the ANSI and ISO committees responsible for the SGML standard, ISO 8879. She serves as Co-Chair of the CALS Industry Work Group Electronic Publishing Committee. Pam also conducts seminars on SGML for the Graphic Communications Association and is an executive board member of the International SGML Users Group.

Oscar A. Goldfarb SAF/ALG The Pentagon

Mr. Oscar A. Goldfarb is the director for supply, maintenance and logistics plans, Office of the Deputy Assistant Secretary of the Air Force (Logistics). He is responsible to the deputy assistant (logistics) in all matters associated with supply and maintenance, as well as logistics planning and research, international logistics, munitions, acquisition logistics and information management systems.

Mr. Goldfarb received a bachelor's degree in industrial psychology from the University of Pennsylvania in 1958. As a distinguished graduate, he received a master's degree in logistics management from the Air Force School of Systems and Logistics in 1967. Mr. Goldfarb served in the U.S. Marine Corps Reserve.

Mr. Goldfarb entered civil service in 1959 with the Navy Aviation Supply Office, Philadelphia, Pennsylvania, where he was an item manager and systems analyst. In 1967 through 1975, he held increasingly responsible positions with the Naval Supply Systems Command, Washington, DC, in provisioning and operations research and as head of supply policy and planning with the Naval Air Systems Command. He was appointed to his present position in February 1977.

Mr. Goldfarb has received numerous professional honors. He was elected a fellow in the Society of Logistics Engineers and he received the 1981 Founders Medal, the Society's highest award. Mr. Goldfarb is the recipient of the Air Force Meritorious Civilian Service Medal and the Exceptional Civilian Service Medal.

Larry D. Griffin WSIG (A&L) The Pentagon

Colonel Larry D. Griffin is Deputy Director of the Weapon Support Improvement Group, Office of the Assistant Secretary of Defense, Production and Logistics. He is responsible for readiness and supportability assessments for major weapon systems and concurrent engineering. Prior to his current position,

Colonel Griffin was Director of Reliability and Maintainability at the Air Force Acquisition Logistics Center and has been responsible for acquisition and service engineering on major Air Force Systems within the Air Force Logistics Command and the AIM-7F Advanced Air-to-Air Missile.

Colonel Griffin received a bachelor's of science degree in Aerospace Engineering from the University of Arizona and a MBA in Operations Management from Wharton Graduate School of Business, University of Pennsylvania.

Robert G. Kiggans South Carolina Research Authority

Mr. Kiggans has over twenty years experience in program and technical management, command and control systems and advanced computing technologies. As Assistant Director and General Manager at the South Carolina Research Authority (SCRA), Mr. Kiggans manages the PDES, Inc. Program, a multi-million dollar joint industry/government effort to accelerate Product Data Exchange Specification (PDES) development and implementation. He also directs long range planning and new business initiatives for a major segment of the SCRA.

As Deputy Director at the Defense Advanced Research Projects Agency (DARPA), Mr. Kiggans was responsible for planning, budgeting and organizing an information science and technology office with a 200 million dollar annual research budget. Mr. Kiggans also played a key role in the development of the multibillion dollar computer/communication modernization of the Worldwide Military Command and Control Information System. Earlier in his career, he was a software systems engineer with Electronic Data Systems (EDS).

A veteran of the Vietnam War, Mr. Kiggans had over 150 B-52 combat missions in Southeas Asia where he was awarded 10 Air Force Medals and the Distinguished Flying Cross. His other military awards included the Defense Superior Service Medal, Defense Meritorious Service Medal, and Air Force Meritorious Service Medal.

Mr. Kiggans is a 1965 graduate of the Citadel and has a masters degree from the Air Force Institute of Technology.

Melvin S. Lammers Air Force Logistics Command Wright Patterson Air Force Base

Melvin S. Lammers is currently assigned as Assistant Chief of the Technology Support Office in the Logistics Management

Systems Center of the Air Force Logistics Command at Wright Patterson Air Force Base. He is also the Director of the DoD Computer-aided Acquisition and Logistics Support (CALS) Test Network (CTN) and the CALS Standards Lead Service Office which is being established in 1990 at AFLC for the Department of Defense. He is also responsible for interface with industry, university, and government research laboratories to advance the use of technology in information systems, computing and communications systems in the Air Force Logistics Command (AFLC). He has extensive background in computer system design and project management with the Air Force. He graduated from the Ohio State University with a degree in Industrial Engineering and is a 1981 graduate of the Industrial College of the Armed Forces at the Defense University, Ft. McNair, Washington, DC.

Mr. Bruce Lepisto Deputy Director, DoD CALS Policy Office OASD(P&L)WS The Pentagon

Bruce Lepisto is the Deputy Director of the Computer-aided Acquisition and Logistic Support (CALS) Policy Office, in the Office of the Secretary of Defense (OSD). He has been involved with the CALS program since its inception, and was Co-editor of the original Institute for Defense Analysis (IDA) CALS Study report that led the Department of Defense to establish the CALS program.

Mr. Lepisto is a career DoD employee with over twenty years experience in both acquisition and operational logistics. Prior to joining the OSD staff in 1984, he worked for the United States Air Force, most recently as Deputy Director for Data Management of the JLC's Joint Depot Maintenance Analysis Group (JDMAG). His Air Force professional experience includes depot posture planning, support policy, data system design and management, and productivity and cost analysis. He is a senior member of the Society of Logistics Engineers, a member of the Steering Committee of the national IGES/PDES Organization, and a member of the ANSI/ASME Y14.26 committee on Computer Aided Preparation of Product Definition Data.

Dr. Michael F. McGrath Director, DoD CALS Policy Office OASD(P&L)WS The Pentagon

Michael F. McGrath is the Director of the CALS Policy Office in the Office of the Secretary of Defense (OSD). He has close to twenty years of weapon system acquisition experience, and is well acquainted with user needs for CALS in both government and defense contractor operations. His previous assignments on the OSD staff included reviewing major weapon system support programs for the Defense Systems Acquisition Review council (DSARC) and serving as principal author of the top level DoD policy directive on "Integrated Logistic Support." Prior to joining the OSD staff in 1980, he held various engineering and logistics management positions in the Defense Logistics Agency and the Naval Air Systems Command. Dr. McGrath holds B.S. and M.S. degrees in Space Science and Applied Physics and a doctorate in Operations Research.

David O. Remington NSWC

Engineer (degree in aeronautical engineering) for thirty years, the last twelve of which have been actively involved in computer-aided-this-and-that as the technology has grown, including being system manager of an eight processor, distributed CAD/CAM system. Worked as part of the IGES/PDES Organization's testing project for the past three years, and as chair of the IGES Verification Testing Methodology Committee for the past year.

H. B. Stormfeltz Northrop Corporation Aircraft Division

H. B. Stormfeltz (Stormy) is currently the manager of the Supportability Technology Development Center. In this position he is responsible for developing Advanced Aircraft Supportability Programs and the activities of the Supportability Technology Development Center. Prior to his current position he was the ILS Director for the company funded F-20 Programs which included developing unique contractor operated support programs worldwide.

In a previous assignment as manager of the F-5/T-38 Support programs, he directed the company's support efforts worldwide in 24 countries. In 1972 he established an Integrated Logistics Support Group to develop international support plans for the COBRA Aircraft European consortium. Before transferring from Engineering to the Logistics Department his assignments included a resident member of the technical consultant team in Europe for the NATO Hawk Weapon System and special assignments involving acquisition of European-developed weapons.

Stormy joined Northrop in 1955 as a Mechanical Design Engineer. He earned a Bachelor of Science Degree in Aeronautical Engineering from Northrop Institute of Technology and a Master's Degree in Engineering from UCLA.

In the fall of 1986 as a result of DoD's Computer-aided Acquisition and Logistics Support (CALS) initiative he became one of NSIA's representatives to the newly formed CALS Industry Steering Group (ISG). Currently, he is the Vice Chairman and Chief Operating Officer, having the responsibility for organizing and coordinating the efforts of the CALS Task Groups.

In July of 1988, Stormy received the Edward M. Greer Award for meritorious service to the Department of Defense activities in the area of Integrated Logistics Support.

Mary Anne Thompson TRW

Ms. Thompson has over 25 years experience in the aerospace community including key management responsibilities on major Intelligence Community program,s leadership in aerospace industry and professional organizations, and national leadership in the field of aerospace eduction. Ms. Thompson currently serves as Manager of the Technical Support Services Department, Systems Division, Federal Systems Group, TRW, Inc., Fairfax, Virginia, with corporate management responsibilities for: development of documentation technologies, training in Military and Government agency documentation standards, Division technical writers, editors, document configuration managers, and CALS-related Technical Manual programs. Ms. Thompson currently serves on the Paperless Technical Manual Study Group of the CALS DoD - Industry Advisory Committee participating in the development of functional requirements and specifications for the next generation of Pageless Technical Documentation. She has served as Consultant to the White House Young Astronaut Program, is listed in personalities of the South (1976 and 1977) and the International Biographical Index (1976), is a 1987 recipient of the Air Force Association National Medal of Merit, and is President of the Air Force Association, D. W. Steele Chapter, which serves over 3,500 aerospace industry and military community members in the Washington area.

Ms. Thompson holds a B.S. degree from the Pennsylvania State University, and graduate degrees from the University of Nebraska and Troy State University.



DoD Initiatives in Computer-Aided Acquisition and Logistics Support

MICHAEL McGRATH
OFFICE OF THE SECRETARY OF DEFENSE

7-4011

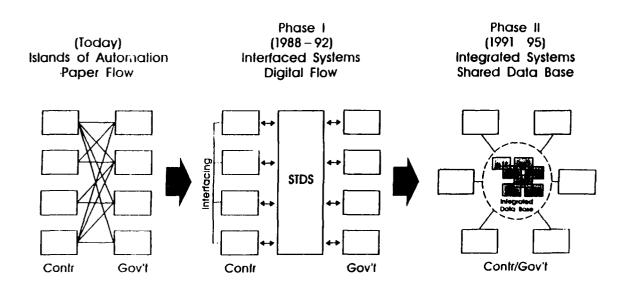
CALS: A Strategy For Change

"I have approved a strategy for transitioning from our current paper-intensive weapon system support* processes to a largely automated and integrated mode of operation, with substantial progress by the end of this decade"

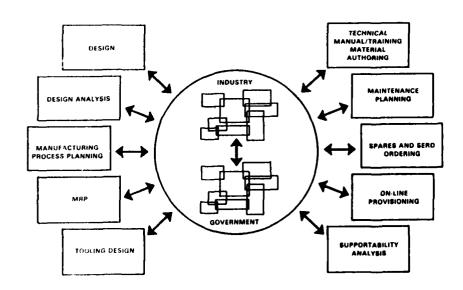
> William H. Taft IV Deputy Secretary of Defense September 1985

^{*} Expanded in 1986 to include design, manufacturing and support

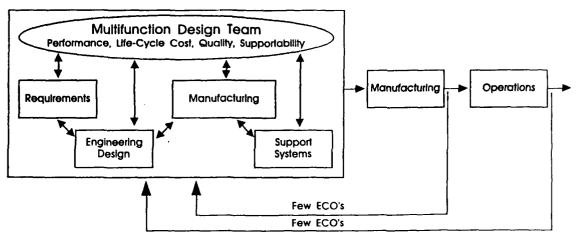
CALS Phased Development



CALS INTEGRATION TARGET



Concurrent Engineering



- Optimize product design, manfacturing process, support process
- Total quality "Get it right the first time"
- Shorten acquisition time, reduce life cycle costs

EXAMPLES OF PROCESS IMPROVEMENTS

CONCURRENT ENGINEERING

o 40-60% reductions in development time, 30% cost reduction, improved quality (IDA Study)

o INTEGRATION OF CONTRACTOR PROCESSES

- o CIM productivity gains of 40-70% (Nat'l Academy of Science)
- o 35% cost avoidance in ILS development (A-12)

o AUTOMATION OF TECHNICAL MANUALS

- o 30-40% savings in authoring (A-12, others)
- o 9:1 reduction in change page cycle time (AFTOMS Goal)
- o 35% improvement in troubleshooting accuracy (AF IMIS)

o SPARES ACQUISITION

- o Online provisioning, ordering saves time and TDY (B-2)
- o 20% reduction in administrative leadtime (EDMICS Goal)
- o 90% reduction in production leadtime (RAMP Goal)

LONG TERM SCHEDULE

1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
										1

CONCEPT FORMULATION

- O CALS Study
- O DepSecDef Memo

DEMONSTRATION/ VALIDATION

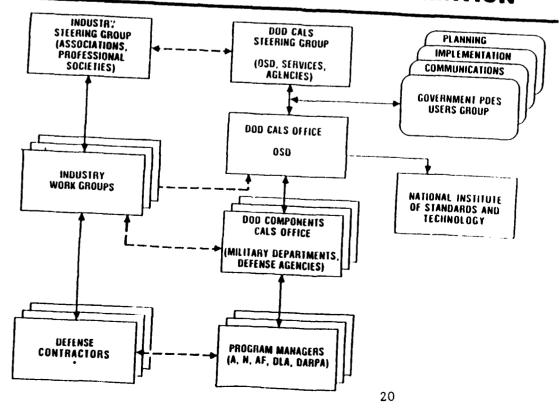
- O CALS Offices, Industry Task Force, NIST
- O Prototypes, Testbed Projects
- O Lead Weapon Systems
- O Initial Standards

FULL SCALE DEVELOPMENT

ROUTINE IMPLEMENTATION

- O DepSecDef Implementation Guidance, DAB Reviews
- O CALS Handbook, Training
- O CALS Test Network for User Applications
- O Vendor Products, Conformance Tests
- O Contractor Integration
- O Infrastructure Modernization, Integration
- O Redesign of Functional Processes
- O Reliance on Contractor Data Bases
- O Digital Delivery & Use

CALS MANAGEMENT ORGANIZATION



CALS Implementation Policy (DEPSECDEF Memo, 5 Aug 1988)

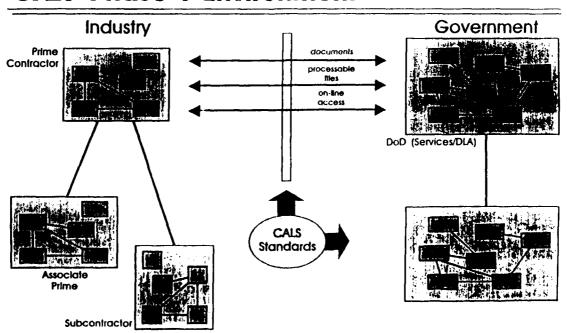
Weapon System Contracts

- New developments obtain proposals for:
 - Integration of contractor data systems
 - DoD access to contractor data bases
 - Contract deliverables in digital form
- Review existing contracts for retrofit opportunities
- "Each application decision shall be made on its own merits with respect to the productivity and quality improvements expected at either prime contractor or subcontractor level"

Infrastructure

■ Program for automated systems to receive, store, distribute and use digital weapon system technical info

CALS Phase I Environment



DoD CALS IMPLEMENTATION

OSD	SERVICES/DLA
DEVELOP AND TEST STANDARDS	INCORPORATE IN WS AND ADP SYSTEMS PARTICIPATE IN CTN
ACQUISITION POLICY	CONTRACTS/RPFs
DEFENSE ACQUISITION REVIEWS	SERVICE ACQUISITION REVIEWS
SPONSOR TECHNOLOGY	FUNDED R&D PROJECTS
DEVELOPMENT AND DEMOS	WEAPON SYSTEM DEMONSTRATIONS
CORPORATE ARCHITECTURE	ADP MODERNIZATION AND INTEGRATION
INTEROPERABILITY ROMTS	SERVICE ARCHITECTURE
CORPORATE PLANNING AND POLICY	SERVICE/DLA CALS OFFICES
INTERFACE WITH INDUSTRY	EDUCATION

9-2463

STANDARDS

ACTIONS SINCE OCT 1988

STANDARDS

TECHNOLOGY

INFRASTRUCTURE

MANAGEMENT

- ACQUISITION GUIDANCE

- o Publication of additional CALS standards, CALS Handbook
- o Draft proposal for PDES version 1.0 to ISO
- o Development of 1989 increment to CALS standards
 - Standards for Technical Manuals
 - Standards for Electronics
 - EDI transfer of CALS files
 - Relational Data Model for LSAR

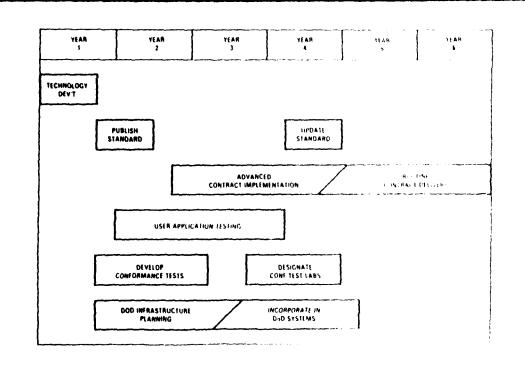
NEAR TERM ACTIONS PLANNED

- o Coordination of 1989 increment to CALS standards
- o Expansion of CALS Test Network projects
- o Top down planning for PDES

Current CALS Standards

DoD Standard	Date	Nat'l/Int'l Standard	Applications
MIL-STD-1840A	DEC 87	. .	
MIL-D-28000	DEC 87	1050	Data Interchange File Management
	500 07	IGES	CAD, Vector Graphics
			Engineering Drawings
MIL-M-28001	FEB 88		TM Illustrations (Optional)
	רכם 88	SGML	Automated Publishing
MIL-R-28002			Tech Manuals
K 20002	DEC 88	GRP 4 Raster	■ Raster Scanned Images
			Engineering Drawings
MIL-D-28003			Tech Manual Illustrations
WIIL-D-26003	DEC 88	CGM	■ Vector Graphics
A.41			
MIL-HDBK-59	DEC 88		IM Illustrations (Preferred)
			■ Implementation Guide
			Model SOW's, CDRI's

IMPLEMENTATION STEPS



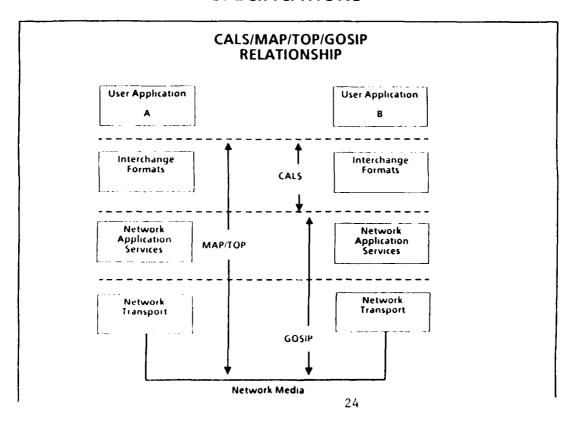
CALS TEST NETWORK

CTN

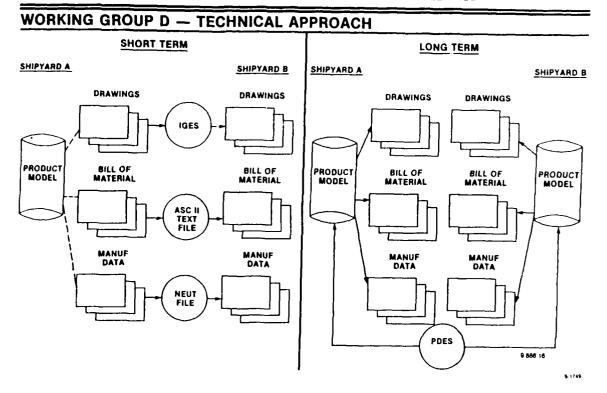
- AIR FORCE WILL BECOME LEAD SERVICE ACTIVITY FOR CALS STANDARDS
 - MANAGE STANDARDS & APPLICATION GUIDANCE
 - CTN AS A SUPPORT FUNCTION
- ACTIVE PARTICIPATION BY ARMY, NAVY, DLA, OTHER AGENCIES & INDUSTRY
- CTN FUNCTIONS
 - DEMONSTRATE NEW TECHNOLOGY
 - PERFORM USER/APPLICATION TESTS
 - PROTOTYPE CONFORMANCE TESTS
 - PROTOTYPE ACCEPTANCE TESTS

3 2461

SPECIFICATIONS



SEAWOLF DIGITAL DATA TRANSFER PROGRAM



PDES Development

Product Data Exchange Specification

- Importance to CALS
 - Logical structure for Phase II shared data base
 - Expands possibilities for industrial networking
- Key players
 - IGES/PDES standards organization
 - PDES, Inc.
 - National PDES testbed (NIST)
 - Government PDES users group

FUTURE STANDARDS

CALS TECHNICAL AND DATA STANDARDS

1989 - EXTENSIONS TO SGML 28001 (ADD'L DOCUMENT TYPES)

PAGELESS TECH MANUALS

STDS FOR ELECTRONIC PRODUCTS (IPC,...)

- OTHER IGES SUBSETS

LSAR RELATIONAL TABLES AND DATA MODEL

EDI TRANSACTIONS

1990-91, - TECHNICAL REPORTS, PLANS SPECS (ODA/ODIF, SPDL)

ILS DATA DICTIONARIES

INITIAL PRODUCT DATA EXCHANGE SPECIFICATION (PDES)

- INITIAL IRDS ENHANCEMENTS

FUNCTIONAL STANDARDS IMPACTED

1989 - LSAR (MIL-STD-1388-2B

TRAINING (MIL-STD-1379,...)

1990-91 - SPARES ACQUISITION, CONFIGURATION MGT, LORA, OTHER

FUNCTIONAL AREAS

9 246.1

TESTBEDS AND TECHNOLOGY

ACTIONS SINCE OCT 1988

- o ATF CALS Demos
- o PDES Testbed activated at NIST. PDES, Inc. operational.
- o Government PDES Users Group report and recommendations
- o Expansion of capabilities in CALS Test Network

NEAR TERM ACTIONS PLANNED

- RAMP Demonstration of PDES-driven parts mfg
- o Tests of delivery of raster scanned engineering drawings
- Prototype of conformance tests in CTN
- o Technology evaluations for A-12 and ATF pageless tech manuals

AUGUIOI I IUIY

ACTIONS SINCE OCT 1988

- o Candidate weapon systems identified for CALS implementation
- o Standing committee established for small business
- o Concurrent Engineering Report and policy memo

NEAR TERM ACTIONS PLANNED

- Reviews of CALS implementation by DAB, Services
- o Contract studies, industry advisory groups
 - CALS cost analysis guidelines
 - Incentives guidance, recommended improvements
 - Functional spec for contractor integrated technical information services
 - Generic risk assessment for CALS data protection
 - Continued process improvement studies (CE, spares, TM's)

CALS WEAPON SYSTEM IMPLEMENTATION

DEPSECDEF AUGUST 5, 1988 MEMO: CALS REQUIREMENTS IN WEAPON SYSTEM ACQUISITION

LEAD WEAPON SYSTEMS

- O ATF ADVANCED TACTICAL FIGHTER (AF)
- O A-12 ADVANCED TACTICAL AIRCRAFT (N)
- O LHX NEW LIGHT HELICOPTER (A)
- O SSN-21 SEAWOLF CLASS SUBMARINE (N)
- O V-22 OSPREY TILT-ROTOR AIRCRAFT (N)

ADDITIONAL CANDIDATES

ARMY	AIR FORCE	NAVY
O PATRIOT O FAADS (NLOS COMPONENT) O HOWITZER IMPROVEMENT O MLRS BINARY CHEMICAL WARHEAD O STRATEGIC DEFENSE SYSTEM O ALL SOURCE ANALYSIS SYSTEM O AIRBORNE ADVERSE WEATHER WS O AAWS-M O AAWS-H O AH-64 IMPROVEMENT PROGRAM O NBC RECON SYSTEM O FOLLOW-ON TO LANCE	O B-2 BOMBER O C-17 AIRCRAFT O SRAM II O LANTRIN O MILSTAIR O JOINT STAR O AWACS RADAR IMPRO O REACT O PEACEKEEPER MISSILE O RAIL GARRISON O SMALL ICBM O CONVENTIONAL CRUISE IO O HYPERVELOCITY MISSILE	

O OTHERS

Paying For CALS

- New weapon system acquisitions
 - Part of competitive cost of new programs
 - Will save money in acquisition
- Retrofit to existing programs
 - Need incentives (e.g. IMIP)
 - Industry recommendations due
- DoD infrastructure systems
 - Line items, industrial funds in DoD component budgets
 - Alternative; purchase services rather than systems

INFRASTRUCTURE

ACTIONS SINCE OCT 1988

- o RFI released for Navy CAD-2
- o DSREDS/EDCARS sites activated. Retrofit planned.

NEAR TERM ACTIONS PLANNED

- o Air Force AFTOMS Milestone 0 Review May
- o Navy/DLA EDMICS contract award June
- Army CALS contract awards August
- o Architecture Guidelines August

Dod Infrastructure Systems

OBJECTIVES

- CAPABILITY TO RECEIVE AND USE DIGITAL DATA
- UNIFIED INTERFACE WITH INDUSTRY
- INTEROPERABILITY AMONG Dod SYSTEMS

ACTIONS TAKEN

- CALS STANDARDS INCORPORATED IN RFP's AND RETROFIT PLANS
 - REPOSITORIES (DSREDS/EDCARS, EDMICS)
 - TECHNICAL MANUALS (AFTOMS)
 - CAD (NAVY CAD-2)
 - SYSTEM INTEGRATION (ACALS)
- Dod Planning Group Reviewing Common ARCHITECTURE REQUIREMENTS

9 246 1

AUTOMATED ENGINEERING DATA REPOSITORIES

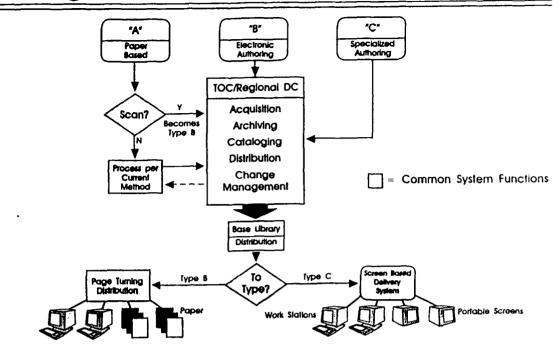
TECHNICAL APPROACH

- CONVERT APERTURE CARDS TO DIGITAL IMAGE FILES
- CAPTURE NEW DRAWINGS AND CAD DATA USING CALS STANDARDS
- MASS STORAGE IN OPTICAL DISK JUKEBOXES
 - OUTPUT EITHER APERTURE CARDS OR DIGITAL FILES

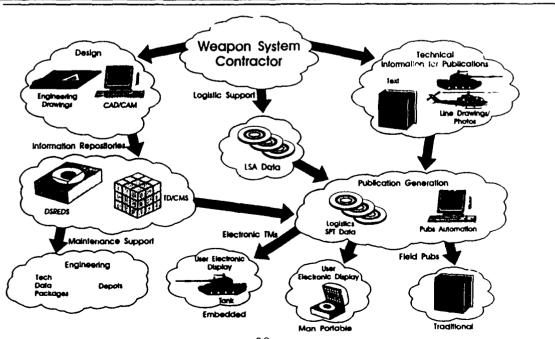
STATUS

- ARMY AND AIR FORCE SYSTEM (DSREDS/EDCARS) UP AND RUNNING AT ALL 12 SITES. DIGITAL INPUT AND OUTPUT BY 1991.
- NAVY AND DLA SYSTEM (EDMICS) IN SOURCE SELECTION. CONTRACT AWARD LATE 1989. PRODUCTION DELIVERIES BEGIN 1990.

Air Force Tech Order Management System (AFTOMS)



Army CALS Conceptual Linkage



MANAGEMENT

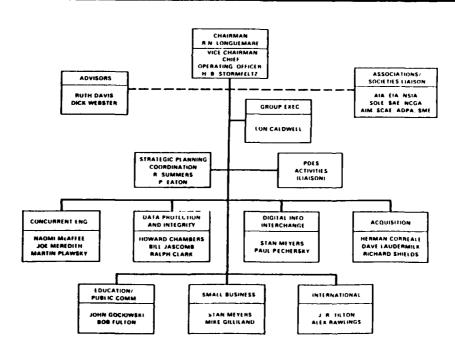
ACTIONS SINCE OCT 1988

- o CALS international discussions in Europe, Canada
- o CALS Training Module in Program Managers Course (DSMC)

NEAR TERM ACTIONS PLANNED

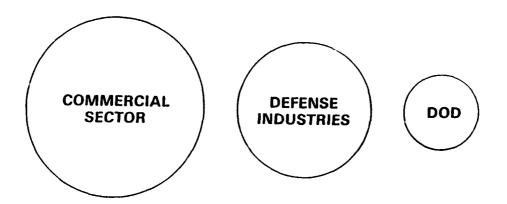
- o 3-Day course on CALS Implementation July
- o CALS Master Plan November
- o CALS Expo '89 December

CALS INDUSTRY STEERING GROUP (ISG)



1 244)

CALS MARKETS



8 1089

Conclusion

Substantial Progress On All Fronts

- CALS strategy is being implemented
 - Standards
 - Technology
 - Acquisition requirements and incentives
 - DoD systems
- CALS requirements being included in RFP's
 - Retrofit opportunities will also be reviewed
- DoD/industry cooperation has been exemplary



COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT (CALS)

Mr. Alfredo Campo

PEO STAMIS

OSD CALS PROGRAM

- DIRECTED BY DEPSECDEF MEMO 24 SEP 85
- INVOLVES ALL MILITARY SERVICES, DOD AGENCIES, AND INDUSTRY
 - •• JOINT DOD/INDUSTRY DEVELOPMENT OF STANDARDS
- INITIAL FOCUS ON TECHNICAL PUBLICATIONS, ENGINEERING DRAWINGS, AND LOGISTIC SUPPORT ANALYSIS (LSA) DATA
- DOD GOAL: BY EARLY 1990'S, ALL NEW WEAPON SYSTEMS WILL BE SUPPORTED ELECTRONICALLY, REPLACING CURRENT PAPER-BASED INFORMATION

PM CALS

ARMY CALS PROGRAM

- IMPLEMENT THE DOD PROGRAM
- EVOLVE FROM CURRENT INITIATIVES
- PROVIDE CAPABILITY ARMY-WIDE
- LEAD WEAPON SYSTEM IS LHX

PM CALS

PEO STAMIS

BUSINESS NEED

INCREASE READINESS
INCREASE COMBAT CAPABILITY
REDUCE COSTS

CONCENTRATE ON DESIGN AND SUPPORTABILITY, AND ESTABLISHING THE INFRASTRUCTURE NECESSARY TO INTEGRATE DATA

PM CALS

CALS BENEFITS FOR THE ARMY

- DATA INTEGRATION
 - MORE EFFECTIVE USE OF TECHNICAL LABOR
 - INCREASE IN TIME AVAILABLE FOR DOCUMENT REVIEW
 - REDUCTION IN ERROR RATE BY SOURCE DATA AUTOMATION
 - INCREASE IN DECISION-MAKING/FORECASTING ACCURACY
 - REDUCTION IN TIME TO GET INFO TO USERS
 - REDUCTION IN DATA STORAGE FACILITIES
- IMPROVED READINESS

PM CALS

PEO STAMIS

WEAPON SYSTEM CONTRACTOR DESIGN LOGISTIC SUPPORT LIST PUBLICATION SENERATION MAINTERANCE SUPPORT TICK BATA UNSUPPORT TOTAL PUBLICATION SENERATION FELD PUBLICATION FELD PUBLICATION

MAN PORTABLE

ARMY CALS CONCEPTUAL ARCHITECTURE

PEO STAMIS

RESOURCE CRITICAL INFORMATION

- 1. LOGISTICS SUPPORT ANALYSIS/RECORD (LSA/R)
- 2. PROVISIONING TECHNICAL DOCUMENTATION (PTD)
- 3. PROCUREMENT DATA PACKAGE (PDP)
- 4. NEW EQUIPMENT TRAINING PLAN (NETP)
- 5. TECHNICAL MANUAL (TM)
- 6. DEPOT MAINTENANCE WORK REQUIREMENT (DMWR)
- 7. DEPOT MAINTENANCE SUPPORT PLAN (DMSP)
- 8. ENGINEERING CHANGE PROPOSAL (ECP)
- 9. EQUIPMENT IMPROVEMENT RECOMMENDATION (EIR)
- 10. EQUIPMENT PERFORMANCE REPORT (EPR)
- 11. SAMPLE DATA COLLECTION (SDC)
- 12. TECHNICAL DATA PACKAGE

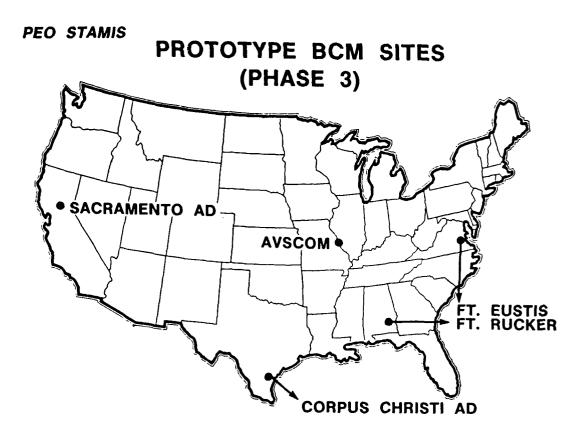
- 13. CATALOGING PROVISIONING SYSTEM (CPS)
- 14. MATERIEL FIELDING PLAN (MFP)
- 15. PRODUCT IMPROVEMENT MANAGEMENT INFORMATION REPORT (PRIMIR)
- 16. ACQUISITION PLAN (AP)
- 17. INTEGRATED LOGISTIC SUPPORT PLAN (ILSP)

PM CALS

PEO STAMIS

SEVEN APPLICATION AREAS FOR INITIAL IMPLEMENTATION

- LOGISTIC SUPPORT ANALYSIS/LOGISTIC SUPPORT ANALYSIS RECORD (LSA/LSAR) INCLUDING MAINTENANCE ALLOCATION CHART (MAC) & REPAIR PARTS AND SPECIAL TOOLS LIST
- PROVISIONING TECHNICAL DOCUMENTATION (TECH DATA PKGS & ENGINEERING DRAWINGS)
- DATA REQUIREMENTS DOCUMENTATION
- BASIS OF ISSUE PLAN FEEDER DATA (BOIPFD), QUALITATIVE & QUANTITATIVE PERSONNEL REQUIREMENTS INFORMATION (QQPRI), NEW EQUIPMENT TRAINING PLAN (NETP)
- TECHNICAL MANUAL SOURCE DATA (TRADITIONAL & INTERACTIVE PUBLICATIONS)
- DEPOT MAINTENANCE WORK REQUIREMENT
- DEPOT MAINTENANCE SUPPORT PLAN

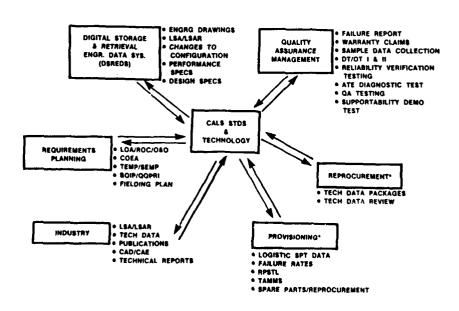


PM CALS

2650114 8213

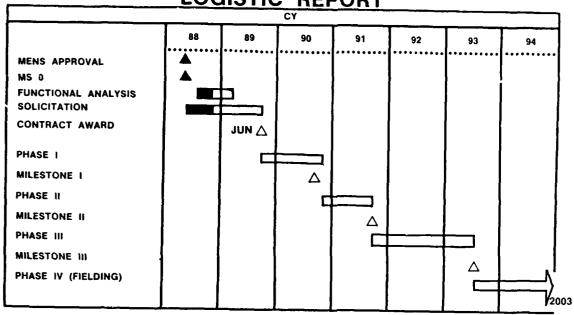
PEO STAMIS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT WHOLESALE LEVEL INFORMATION FLOW



. HAS INTERFACE WITH CCSS

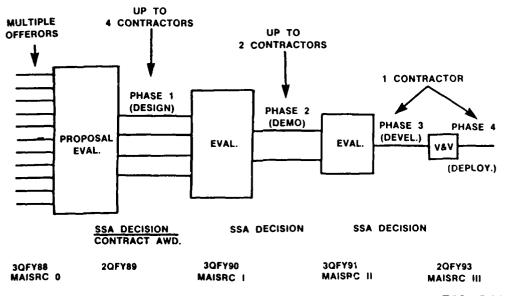
PEO STAMIS
COMPUTER-AIDED ACQUISITION AND
LOGISTIC REPORT



PM CALS

PEO STAMIS

PROGRAM STRATEGY



PHASED APPROACH

MILESTONE 0 - MISSION NEED APPROVAL

PHASE 1: CONCEPT DESIGN (JUN 89 - MAR 90)

- CALS ARCHITECTURE CONTRACTS AWARD
- 2 4 CONTRACTORS
- DELIVERABLES
 - CONCEPT DEVELOPMENT
 - •• TRADE OFF ANALYSES/LCCE
 - CALS ARCHITECTURE
 - •• TRANSITION PLAN
- EVALUATION:
 - OVERALL SYSTEM CONCEPT AND ARCHITECTURE
 - •• PROJECTED COSTS FOR DEVELOPMENT AND FIELDING

PM CALS

PEO STAMIS

PHASED APPROACH

MILESTONE 1 - SELECTION OF CONCEPTS FOR DEMONSTRATION PHASE 2: DEMONSTRATION (JUL 90 - JAN 91)

- 2 CONTRACTORS
- FEATURES:
 - ●● IWSDB SCHEMA/GLOBAL INDEX
 - •• INTERACTIVE LSAR
 - •• TECH PUBS DOWNLOAD
 - •• DISTRIBUTION TECHNICAL DOCUMENTATION USING MIL STD 1840A
 - •• ILS WORKBENCH
- DELIVERABLES:
 - •• OPERATIONAL DEMONSTRATION OF TECHNICAL CONCEPT
 - •• PROPOSALS FOR DEVELOPMENT AND FIELDING
- EVALUATION:
 - **•• TECHNICAL CAPABILITY**
 - •• PROJECTED COSTS & SCHEDULE

PHASED APPROACH

MILESTONE II - SELECTION OF ONE CONCEPT FOR DEVELOPMENT

PHASE 3: CONCEPT DEVELOPMENT (JUN 91 - DEC 92)

- 1 DEVELOPMENT CONTRACTOR
- DEVELOPMENT OF BCM
- DELIVERABLES:
 - •• SYSTEM SOFTWARE
 - DOCUMENTATION
 - •• HARDWARE FOR TEST SITES
- EVALUATION:
 - •• SYSTEMS ACCEPTANCE TESTING OF 3 LEVELS AT 6 SITES

PM CALS

PEO STAMIS

PHASED APPROACH

MILESTONE III - FIELDING DECISION
PHASE 4: DEPLOYMENT (APR 93 - SEP 03)

- DEVELOPMENT CONTRACTOR
- IMPLEMENTATION/FIELDING TO REMAINING 51 BCM SITES
- DELIVERABLES:
 - •• HARDWARE/SOFTWARE
 - ●● SYSTEM INTEGRATION/INSTALLATION
 - •• TRAINING
 - •• SYSTEM MANAGEMENT



Computer Aided Logistics & Acquisition Support

Mr. Oscar Goldfarb

Technical

- Engineering drawings/descriptive data
 - **■** Describes weapon system
 - Part reprocurement
- **■** Technical orders
 - **Describes** how weapon system is used and must be maintained
 - **■** Maintenance manuals
- **Logistics support analysis**
 - Describes weapon system in logistics terms so that support can be acquired
 - Training
 - Failure analysis
 - Parts
 - Skill levels of maintenance personnel

The 1919 U.S. Army Air Service Flying Regulations

- Pilots should carry hankies in a handy position to wipe off goggles
- Do not trust altitude instruments
- Motors have been known to stop during a long slide, if pilot wishes to use motor for landing he should open throttle
- Do not use aeronautical gas in cars and motorcycles
- It is advisable to carry a good pair of pliers in a position where both pilot and passenger can reach them in case of an accident
- Joy rides will not be given to civilians

Engineering Data Repositories Hold 40,000,000 Drawings

- Manage 240,000 different technical orders
 - 20,000,000 pages
 - 40% graphics 60% text
- Tech data growing

<u>.O.s</u>
00

- Data is volatile
 - 2,000,000 pages change annually

Efforts Underway to Automate Technical Orders

- First generation automated technical order system
 - T.O. page update capability exists at each Air Logistics Center
 - Building "electronic" data base
 - Automated paper format

Improved Technical Data System

Second Generation

- Developed by Northrop for Black Program
- First integrated T.O. system
 - Could move away from paper format
 - Automated links for related information

(ITDS)

Improved Technical Data System

- A "paperless" system for the authoring and use of technical orders
- Comprised of a producer system and a user system
 - Producer system currently supports authoring and delivering technical data to current CALS standards
 - User system is being developed to provide electronic delivery to the technician for weapon system support at all levels
- Interfaces with the Logistics Support
 Management Information (LSMIS) and
 engineering databases to provide an integrated
 technical data development/delivery environment
- 30% savings in technical data development

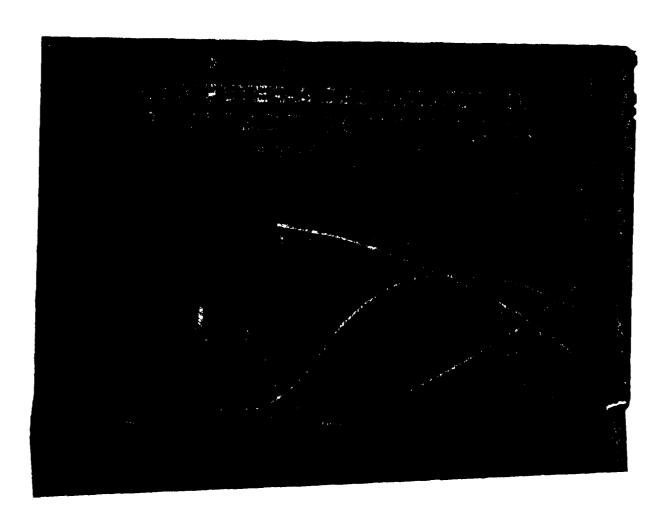
Integrated Maintenance Information System

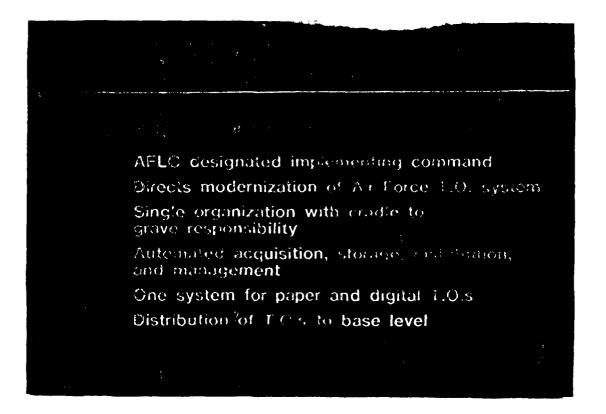
Third Generation

- R&D program to establish knowledge based system
 - Link T.O., diagnostics and maintenance info systems
 - Interactive diagnostics
 - Portable flight line terminals
- 25% improvement in diagnostics during flight line demo program

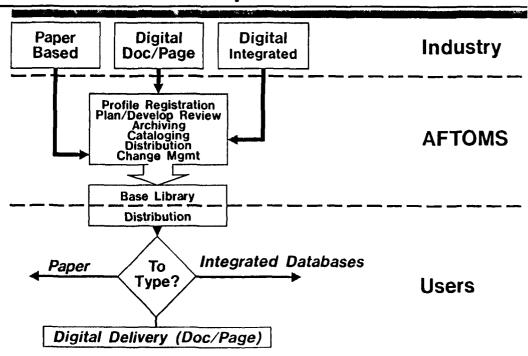
Categorization of T.O.s

Developer & End User Perspective		Infrastructure Perspective		
Unintelligent	■ Raster storage ■ Page format	Type A ■ Page format paper		
Semi-intelligent	■ Electronic generation & storage ■ Page format	Type B Page format-digital delivery Page turner usage (paper or display)		
Intelligent	Relational data structureInteractive use	Type C Screen oriented Digital delivery Electronic display		

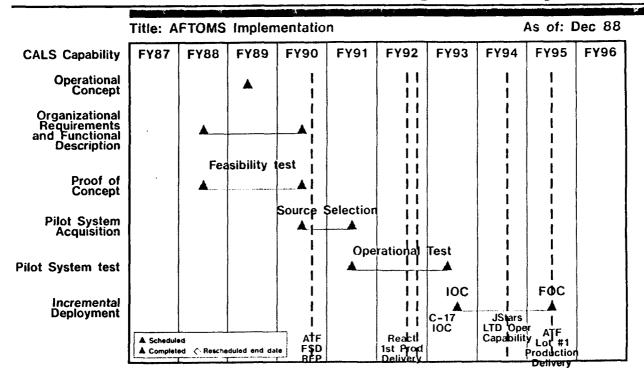




Technical Order Functional Concept



Air Force Technical Order Management System



Concept Integration

- ATOS automates the paper change process
- AFTOMS manages the overall T.O. requirement
- IMIS provides R&D for data base integration
- ITDS and follow-on programs implement IMIS technology at base level

Automating Technical Orders

- Moving from paper to automated T.O. will be major cultural shift
- Readiness issues must be addressed
- Need contract specification now for weapon systems under development to capture "intelligent" data
 - User systems not yet defined/programmed
 - Specifications under development

Benefits of **Technical Order Automation**

- Cost
 - Reduce development cost \$135 Million per year
 - Reduce change cost \$100 Million per year

 - Reduce life cycle cost \$583 Million per major weapon system
- Timeliness
 - Reduce change cycle by 115 days
 - Reduce acquisition time
- Mission effectiveness
 - Increase usefulness of T.O. information
 - Better fault detection
 - Better fault isolation
 - Reduce weight and volume of T.O.
 - 1500 lbs on C-17

Computer Aided Acquisition and Logistics Support



Industry

Steering

Group

Mr. Harold Stormfeltz

8802-33 (1

EVENTS

SEPTEMBER 1985 - CALS POLICY INITIATED

SPRING 1986 - ORGANIZED (DOD & INDUSTRY)

AUGUST 1988 - CALS IMPLEMENTATION POLICY

DECEMBER 1988 - JANUARY 1989 - STANDARDS & MIL-HDBK-59 RELEASED

CALS POLICY INITIATIVE (DEPSECDEF MEMORANDUM) (SEPTEMBER 1985)

OBJECTIVES

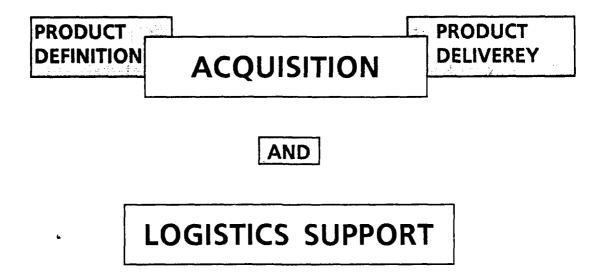
- ACCELERATE INTEGRATION OF R&M DESIGN TOOLS INTO CONTRACTOR CAD/CAE SYSTEMS
- AUTOMATE CONTRACTOR PROCESSES FOR GENERATING LOGISTIC TECHNICAL INFORMATION
- RAPIDLY INCREASE DOD CAPABILITY TO RECEIVE, DISTRIBUTE AND USE TECHNICAL INFORMATION IN DIGITAL FORM
 - BY 1990, NEW MAJOR WEAPON SYSTEMS WILL ACQUIRE TECHNICAL INFORMATION IN DIGITAL FORM

CALS IMPLEMENTATION POLICY (DEPSECDEF MEMO, 5 AUG 1988)

WEAPON SYSTEM CONTRACTS AFTER SEP 88

- O NEW DEVELOPMENTS -- OBTAIN PROPOSALS FOR:
 - -- INTEGRATION OF CONTRACTOR DATA SYSTEMS
 - -- DOD ACCESS TO CONTRACTOR DATA BASES
 - -- CONTRACT DELIVERABLES IN DIGITAL FORM
- o REVIEW EXISTING CONTRACTS FOR RETROFIT OPPORTUNITIES
- o "EACH APPLICATION DECISION SHALL BE MADE ON ITS OWN MERITS WITH RESPECT TO THE PRODUCTIVITY AND QUALITY IMPROVEMENTS EXPECTED AT EITHER PRIME CONTRACTOR OR SUBCONTRACTOR LEVEL"

"COMPUTER AIDED"



8802 33 (33

DEPARTMENT OF DEFENSE COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT (CALS) PROGRAM IMPLEMENTATION GUIDE MIL-HDBK-59

THE HANDBOOK PROVIDES INFORMATION AND GUIDANCE TO PERSONNEL RESPONSIBLE FOR THE ACQUISITION AND USE OF WEAPON SYSTEM TECHNICAL DATA. ITS PURPOSE IS TO ASSIST IN THE TRANSITION FROM PAPER-INTENSIVE PROCESSES TO DIGITAL DATA DELIVERY AND ACCESS. IT ALSO SUPPORTS THE STRUCTURING OF CONTRACT REQUIREMENTS TO ACHIEVE INTEGRATION OF VARIOUS CONTRACTOR AUTOMATED CAPABILITIES FOR DESIGN, MANUFACTURING, AND LOGISTIC SUPPORT.

CALS

PURPOSE

IMPROVE INDUSTRY AND DOD PRODUCTIVITY AND QUALITY
AND THUS IMPROVE SUPPORTABILITY, MILITARY READINESS
AND COMBAT EFFECTIVENESS.

(REF. MIL-HDBK-59)

8802-33 (31)

CALS

OBJECTIVES

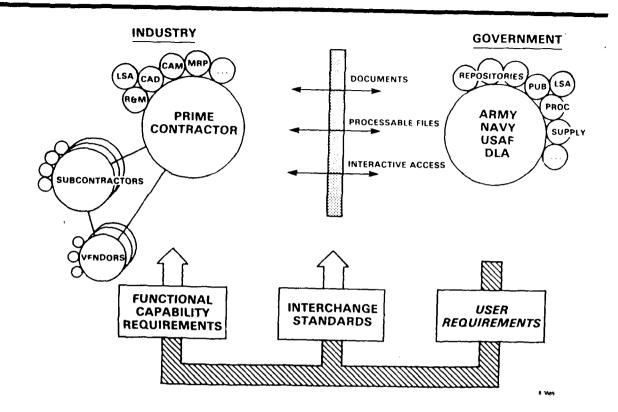
TO ACCELERATE THE INTEGRATION OF DESIGN TOOLS SUCH AS THOSE FOR RELIABILITY AND MAINTAINABILITY INTO CONTRACTOR COMPUTERAIDED DESIGN AND ENGINEERING SYSTEMS AS PART OF A SYSTEMATIC APPROACH THAT SIMULTANEOUSLY ADDRESSES THE PRODUCT AND ITS LIFE CYCLE MANUFACTURING AND SUPPORT REQUIREMENTS.

TO ENCOURAGE AND ACCELERATE THE AUTOMATION AND INTEGRATION OF CONTRACTOR PROCESSES FOR GENERATING WEAPON SYSTEM TECHNICAL DATA IN DIGITAL FORM.

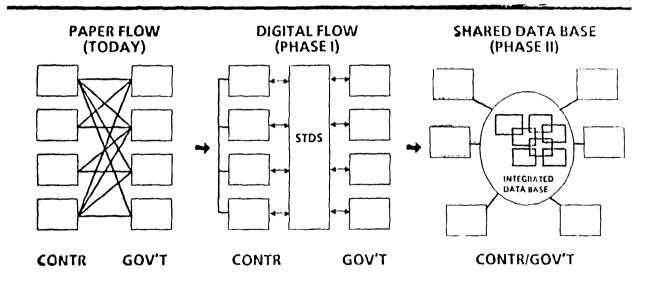
TO RAPIDLY INCREASE DOD'S CAPABILITIES TO RECEIVE, STORE, DISTRIBUTE, AND USE WEAPON SYSTEM TECHNICAL DATA IN DIGITAL FORM TO IMPROVE LIFE CYCLE MAINTENANCE, TRAINING, AND SPARE PARTS REPROCUREMENT, AND OTHER SUPPORT PROCESSES.

(REF. MIL-HDBK-59)

DIGITAL INFORMATION EXCHANGE



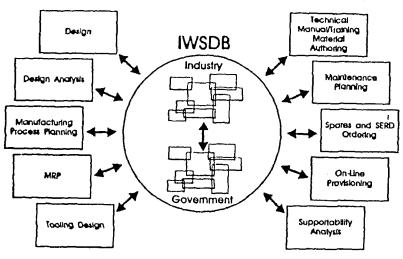
CALS EVOLUTION



- INTEGRATION PROGRAM
- TRANSITION TO "NEAR PAPERLESS" DESIGN, MANUFACTURING, SUPPORT
- GAIN BENEFITS OF A HIGHLY AUTOMATED AND INTEGRATED SYSTEM

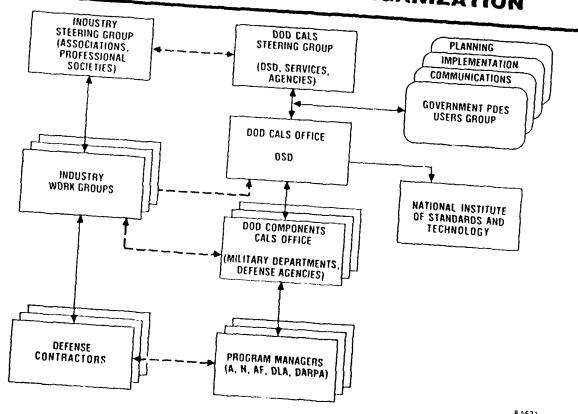
Phase II Integration Target

Integrated Weapon System Data Base (IWSDB)

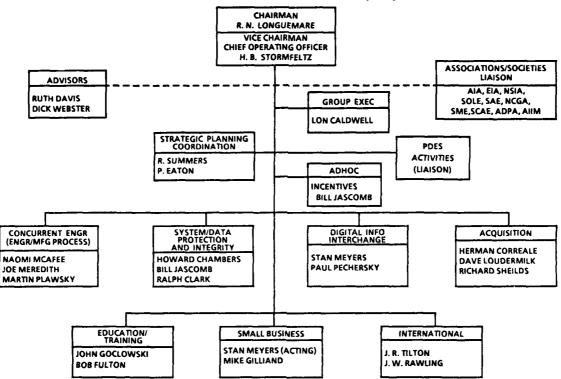


Standard interface through data dictionary

CALS MANAGEMENT ORGANIZATION

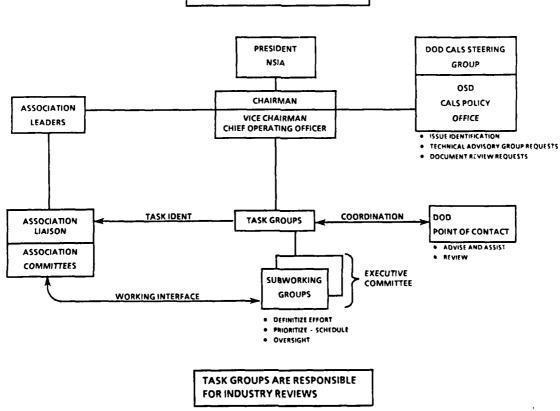


CALS INDUSTRY STEERING GROUP (ISG)



8802-33 (2)

OPERATIONS



(ISG) ACCOMPLISHMENTS

- ASSISTED DOD IN THE REVIEW OF CORE I STANDARDS. (MIL-STD-1840, MIL-M-28000 SERIES ETC.)
- PROVIDED INPUTS TO "MILITARY HANDBOOK PROGRAM IMPLEMENTATION GUIDE." (MIL-HDBK-59, 20 DEC 88)
- PROVIDED RECOMMENDATIONS TO OSD CALS POLICY OFFICE AND DOD CALS STEERING GROUP.
- PROMOTED CALS STRATEGY THROUGHOUT INDUSTRY.

(ISG) INDUSTRY EFFORT: 75 MAN YEARS (1987)

450 ACTIVE PARTICIPANTS (1988)

PRIMARY CONCERNS

- EDUCATION OF BOTH INDUSTRY AND DOD
- BUSINESS ELEMENTS ARE LAGGING IMPLEMENTATION PLANS.
- DOCUMENTATION DEVELOPMENT; DID'S SPECIFICATIONS ETC, MUST BE ACCELERATED
- SYSTEMS/DATA PROTECTION POLICY IS REQUIRED ALONG WITH THE PROPER MECHANISM FOR REQUIRING PROGRAMS TO HAVE A PROTECTION PLAN
- CONCURRENT ENGINEERING MUST BE INTEGRATED UNDER THE CALS STRATEGY
- RESOLVE DIFFERENCES BETWEEN DOD AND MILITARY SERVICE STANDARDS AND POSSIBILITY OF MILITARY SERVICES USING DIFFERENT STANDARDS
- APPARENT MULTIPLE DATA DICTIONARY ACTIVITIES

SUMMARY

DOD/INDUSTRY CHALLENGE

CALS STRATEGIES WILL APPLY TO 15-20 PERCENT OF THE WEAPON SYSTEMS BY THE YEAR 2000 ----

WHAT ABOUT THE EXISTING SYSTEMS THAT WILL STILL BE IN SERVICE (80-85 PERCENT)?

MIGRATE CALS STRATEGIES INTO SUPPORTING EXISTING SYSTEMS TO REDUCE 0&S COSTS.

RRG* **

SUMMARY

- INDUSTRY COMMITTED TO ACHIEVING PRODUCTIVITY/QUALITY GAINS THROUGH AUTOMATION
- INDUSTRY IMPLEMENTING SYSTEMS TO SATISFY CALS STRATEGY (77% OF 1987 SURVEY RESPONDEES HAVE DIGITAL INTERFACES ESTABLISHED)
- CONCERTED PLANNING AND INVESTMENT BY BOTH INDUSTRY AND DOD REQUIRED TO MEET GOALS
- INDUSTRY AND DOD MUST ACCELERATE IN-HOUSE TRAINING/ INDOCTRINATION PROGRAMS TO MEET 1990 AND TAFT'S IMPLEMENTATION LETTER
- TEST NETWORK ACTIVITIES UNDERWAY. NEED INDUSTRY SUPPORT

INDUSTRY STEERING GROUP NEEDS YOUR PARTICIPATION

Col. Larry D. Griffin

CONCURRENT ENGINEERING

OVERVIEW

- DEFINITION
- BACKGROUND
- STUDIES SUMMARY
- **CURRENT ACTIVITIES**
- SUMMARY

DEFINITION

AN INTEGRATED PROCESS WITHIN WHICH THE PRODUCT AND THE MANUFACTURING AND SUPPORT PROCESSES ARE ENGINEERED TOGETHER WITH EMPHASIS ON EFFICIENCY, INCREASED QUALITY AND REDUCED COST.

9 1733

CONCURRENT ENGINEERING

WHY DoD IS INTERESTED

CASE STUDY	cost	SCHEDULE	QUALITY
McDONNELL DOUGLAS	60% ON SAVINGS ON BID FOR REACTOR AND MISSILE PROJECTS	SIGNIFICANT SAVINGS (REDUCTION FROM 45 WEEKS TO 8 HOURS) IN ONE PHASE OF HIGH SPEED VEHICLE PRELIMINARY DESIGN. 18 MONTH SAVING ON TAV 8B DESIGN	SCRAP REDUCED 58%, REWORK COST REDUCED 29%, AND NON CONFORMANCES REDUCED 38%, WELD DEFECTS PER UNIT DECREASED 70% 68% FEWER CHANGES ON REACTOR 68% FEWER DRAWING CHANGES ON TAV 88
BOEING BALLISTIC SYSTEMS DIVISION	REDUCED LABOR RATES BY \$28/HOUR, COST SAVINGS 30% 40%	PART AND MATERIALS LEAD TIME REDUCED BY 30% ONE PART OF DESIGN ANALYSIS REDUCED BY OVER 90%.	FLOOR INSPECTION RATIO DECREASED BY OVER 2/3, MCTEINAL SHORTAGES REDUCED FROM 12% TO 0. 99% DEFECT FREE OPERATION
ATUT	COST OF REPAIR FOR NEW CIRCUIT PACK PRODUCTION CUT AT LEAST 40%	TOTAL PROCESS TIME REDUCED TO 46% OF BASELINE FOR SESS 'M	DEFECTS REDUCED BY 30% TO 87%
DEERE & COMPANY	30% ACTUAL SAVINGS IN DEVELOPMENT COST FOR CONSTRUCTION EQUIPMENT	60% SAVINGS IN DEVELOPMENT TIME.	NUMBER OF INSPECTORS REDUCED BY 2/3
HEWLETT PACKARD CO . INSTRUMENT DIVISION	MANUFACTURING COSTS REDUCED 42%	REDUCED DEVELOPMENT CYCLE TIME 35%	PRODUCT FIELD FAILURE HATE REDUCED 60% SCRAP ALD REVOUR REDUCED 75%
IBM	PRODUCT DIRECT ASSEMBLY LABOR HOURS REDUCED 45%	SIGNIFICANT REDUCTION IN LENGTH OF PMT DESIGN CYCLE 40% REDUCTION IN ELECTRONIC DESIGN CYCLE	FEWER ENGINEERING CHANGES GUARANTEED PRODUCIBILITY AND TESTABILITY
NOHTHROP	30% SAVINGS ON BID ON A MAJOR PROJECT	PART AND ASSEMBLY SCHEDULE REDUCED BY 50% ON TWO MAJOR SUBASSEMBLIES SPAN TIME REDUCED BY 60%	NUMBER OF ENGINEERING CHANGES REDUCED BY 45% DEFECTS REDUCED BY 35%

9 1319

CONCEPTUAL FRAMEWORK

SEQUENTIAL ENGINEERING

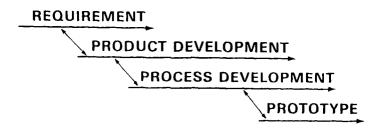
REQUIREMENT

PRODUCT DEVELOPMENT

PROCESS DEVELOPMENT

PROTOYPE

CONCURRENT ENGINEERING

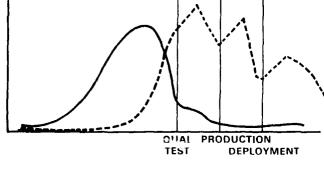


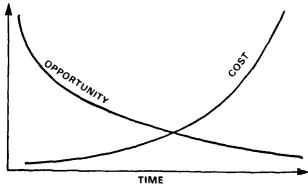
9 1319

CONCURRENT ENGINEERING

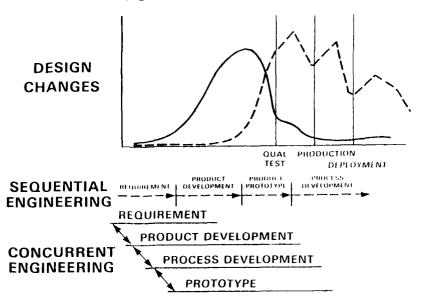
CONCEPTUAL FRAMEWORK

DESIGN CHANGES









9 1319

CONCURRENT ENGINEERING

CONCEPTUAL FRAMEWORK

WHAT -→ HOW

- REDUCED DESIGN CYCLE TIME
- ROBUST PRODUCT & **PROCESSES**
- REDUCED DESIGN CYCLES
- EARLY VERIFICATION OF CRITICAL PRODUCT & **PROCESSES CHARACTERISTICS**

- REDUCED COST
- EARLY DESIGN CHANGES
- RAPID PROTOTYPING

- INCREASED QUALITY
- REDUCED DESIGN CHANGES
- EARLY INTEGRATION **VERIFICATION**

- REDUCED **DEVELOPMENT** TIME
- HIGH MANUFACTURING YIELDS
- GOOD UNDERSTANDING OF **CUSTOMER REQUIREMENTS**
- REDUCED INSPECTION REQUIREMENTS
- JOINT OPTIMIZATION OF CRITICAL PRODUCT & PROCESS CHARACTERISTICS
- STREAMLINED DEVELOPMENT EARLY IDENTIFICATION & **PROCESS**
- **RESOLUTION OF BOTTLENECKS**
- REDUCED QUALIFICATION **TESTING**
- PROBLEM PREVENTION **TESTING STRATEGY**

9 1319

CONCEPTUAL FRAMEWORK

- ◆ TOTAL SYSTEM ENGINEERING FRAMEWORK FOR SYSTEM INTEGRATION AND OPTIMIZATION
- STREAMLINED DEVELOPMENT PROCESSES REDUCE NON-VALUE ADDED WORK
- MULTIDISCIPLINE TEAMS INTEGRATED PRODUCT AND PROCESS ENGINEERING
- QUALITY ENGINEERING METHODS EFFICIENT PRODUCT AND PROCESS OPTIMIZATION
- CAD/CAE/CAM MANAGEMENT OF CHANGE, RAPID TRANSFER OF BENEFITS, REDUCTION OF ERRORS. EFFICIENT DATA COLLECTION AND ANALYSIS. EFFECTIVE INTEGRATION

9 1319

CONCURRENT ENGINEERING

RELATIONSHIP TO CALS

- CALS R&M
- ADDRESSES CAE FUNCTIONAL R&M DESIGN DECISION SUPPORT TD FACILITATE CONCURRENT ENGINEERING
- CALS STANDARDS ADDRESSES THE SHARING OF DATA TO FACILITATE CONCURRENT ENGINEERING IN THE AREAS OF REQUIREMENTS, DEVELOPMENT. ENGINEERING, MANUFACTURING, AND SYSTEM SUPPORT
- CALS DOD
 - INFRASTRUCTURE ADDRESSES THE RECEIPT, STORAGE, AND DISTRIBUTION OF DATA FOR BOTH GOV'T INTERACTION IN CONCURRENT ENGINEERING AND INDUSTRY ACCESS TO SERVICE DATA ON FIELDED SYSTEMS.
- CALS ACQUISITION GUIDANCE
 - ADDRESSES THE NEED FOR CONTRACT REQUIREMENTS AND INCENTIVE MECHANISMS TO FACILITATE INDUSTRY INVESTMENTS IN **AUTOMATION AND INTEGRATION**

BACKGROUND

• USD(A) MEMORANDUM — APRIL 1988

• INSTITUTE FOR DEFENSE ANALYSIS TASK FORCE

OSD/SERVICES/INDUSTRY 70+ ORGANIZATIONS

PYMATUNING GROUP

INDUSTRY EXECUTIVES 20+ COMPANIES

 CALS TASK FORCE ON **DESIGN INTEGRATION**

TECHNICAL—DOD/INDUSTRY **40+ COMPANIES**

CONCURRENT ENGINEERING

DOD/INDUSTRY CONCURRENT **ENGINEERING TASK FORCE**

ELECTRONICS

AIRFRAME

ENGINE

SHIPS

IBM TI

LOCKHEED BOEING GD **GRUMMAN** GE P&W **GARRETT**

NEWPORT NEWS

LITTON GE ITT

HONEYWELL

BELL **NORTHROP**

WESTINGHOUSE **T&TA**

McDONNELL DOUGLAS

HUGHES

TRW MCC **HUGHES** **AEROSPACE**

LAND VEHICLES

MUNITIONS

COLLEGES **HARVARD**

GD JÓHN DEERE

FORD

AEROJET

MIT CARNEGIE MELLON

PRINCETON RPI

UNIV OF MARYLAND UNIV OF WISCONSIN UNIV OF IOWA

UNIV OF RHODE ISLAND

PYMATUNING GROUP EXECUTIVE TASK FORCE

AIRCRAFT	<u>ELECTRONICS</u>	<u>OTHER</u>
BOEING	HUGHES AIRCRAFT	AEROJET
GENERAL DYMANICS	HUGHES RADAR	BATTELLE
GRUMMAN	IBM FEDERAL SYSTEMS	DRAPER LABS
LOCKHEED	IBM COMPUTERS	IDA
MCDONNELL DOUGLAS	ITT	IITRI
NORTHROP	WESTINGHOUSE ELECTRONIC SYSTEMS	SAIC
	WESTINGHOUSE DEFENSE RADAR	SRI

CONCURRENT ENGINEERING

CALS TASK FORCE ON DESIGN INTEGRATION ELECTRONICS

PRIME CONTRACTORS	ELECTRONICS CONTRACTORS	CONSULTANTS & UNIVERSITIES	GOVERNMENT
MCDONNELL AIRCRAFT	LOCKHEED-ELECTRONICS	VIRGINIA TECH	OASD
RAYTHEON	HARRIS	UNIV OF MARYLAND	NOSC
BOEING AEROSPACE	TEXAS INSTRUMENTS	SIEGFRIED ENT	USAF
MARTIN MARIETTA	ROCKWELL COLLINS	SIGMA PLUS	AFHRL
LOCKHEED-GEORGIA	WESTINGHOUSE	MCC	
NORTHROP	LITTON AMECOM	DACOM	
GENERAL DYNAMICS	GOULD	PCA	
ROCKWELL INTERNATIONAL	SANDERS	GIORDANO	
HONEYWELL	UNISYS	VEDA	
TRW	IBM		
	AT&T		

CALS TASK FORCE ON DESIGN INTEGRATION MECHANICAL SYSTEMS

CONTRACTORS

ALLIED-SIGNAL AEROSPACE ALLISON GAS TURBINE DIV. G.M. AUTOMATED IMAGES AVONDALE SHIPBUILDING **BMY CORPORATION** BATH IRON WORKS BELL HELICOPTER TEXTRON CADILLAC GAGE TEXTRON
CONTROL DATA CORPORATION FMC GROUND SYSTEMS GE AIRCRAFT ENGINES GD LAND SYSTEMS, FT. WORTH GRUMMAN AIRCRAFT SYSTEMS LOCKHEED AERO SYSTEMS MCDONNELL AIRCRAFT, HELICOPTER NEWPORT NEWS SHIPBUILDING PRATT & WHITNEY
ROCKWELL INTERNATIONAL SARGETN CONTROLS SIKORSKY AIRCRAFT SPERRY MARINE, INC WESTINGHOUSE ELECTRONICS YORK INTERNATIONAL

CONSULTANTS UNIVERSITIES

ADVANCED TECHNOLOGY
D. APPLETON COMPANY
INTERGRAPH
MANAGEMENT SCIENCES
PROSPECTIVE COMPUTER ANALYSTS
SIGMA PLUS
STRUCTURAL DYNAMICS RESEARCH CORP.
W. G. BEAZLEY ASSOCIATION
UNIVERSITY OF IOWA
UNIVERSITY OF NEW MEXICO

GOVERNMENT

AF HUMAN RESOURCES LAB
ARMY ARMEMENT R&D CENTER
DOD PROD. ENG. SERVICES OFFICE
NAVSEA
NAVAL AVIATION DEPOT
OASD (P&L) CALS
US ARMY MAN ENG. COLLEGE

CONCURRENT ENGINEERING

STUDIES SUMMARY

- INSTITUTE FOR DEFENSE ANALYSIS TASK FORCE
 - CASE STUDIES
 - METHODS
 - CAE/CAD/CAM
 - QUALITY ENGINEERING
 - MANAGEMENT
 - MULTIDISCIPLINE TEAMS
 - SOURCES OF TRAINING
 - R&D FRAMEWORK
 - ACQUISITION AND TECHNOLOGY APPROACH
- PYMATUNING TASK FORCE
 - "INHIBITORS"
 - STRATEGY
- NSIA-CALS INDUSTRY TASK FORCE
 - CAE/CAD/CAM METHODS FOR R&M INTEGRATION
 - STRATEGY

STRATEGY

- IMPLEMENT THROUGH ACQUISITION PROCESS "PROCESS EMPHASIS"
- DOD LEAD THROUGH EXAMPLE
- INCREASED TECHNOLOGY FOCUS ON TOTAL PROCESS IMPROVEMENT
- INDUSTRY RESPOND WITH INNOVATION IN PROCESSES

CONSIDERATIONS

- INDUSTRY WILL ADOPT CONCURRENT ENGINEERING TO ENHANCE COMPETITIVE POSITION
 - IF DOD ENCOURAGES AND ENABLES
 - RECOGNIZES INNOVATION
- BARRIERS INCLUDE:
 - DOD FRACTIONATION OF REQUIREMENTS
 - TOO LITTLE ATTENTION TO PROCESS
 - TOO MANY "HOW TO" SPECIFICATIONS
 - LACK OF INCENTIVES

4/11/1

CONCURRENT ENGINEERING

CURRENT ACTIVITIES

- ACQUISITION IMPLEMENTATION
- NEW MANUFACTURING TECHNOLOGY GUIDELINES
- REVISION OF DOD TEMPLATES
- REVISION OF KEY DOD ENGINEERING PROCESS RELATED STANDARDS
- NEAR TERM EDUCATION/TRAINING
- LONG TERM EDUCATION/TRAINING
- FOCUSED DOD TECHNOLOGY PROGRAM
- INDUSTRY INCENTIVES
- PILOT PROGRAMS
- OVERALL STRATEGY

OSD/SERVICES/INDUSTRY
TASK FORCES
OSD/AF/INDUSTRY
TASK FORCE
OSD/SERVICES/DMB-DSB
TASK FORCE
OSD/SERVICES/INDUSTRY
TASK FORCES

OSD/SERVICES
SERVICES/INDUSTRY
TASK FORCE
SERVICES
PGI
SERVICES
DMB

STATUS SUMMARY

- o STUDIES
 - OO INSTITUTE FOR DEFENSE ANALYSIS
 - INITIAL REPORT MAR 1989
 - FOLLOWUP ON CASE STUDIES OCT 1989
 - R&D ASSESSMENTS MAR 1990
 - OO PYMATUNING GROUP, INC.
 - INITIAL REPORT JAN 1989
 - INDUSTRY FORUM CONTINUING
 - DOD STRATEGY MAR 1990
 - **OO CALS CONCURRENT ENGINEERING TASK GROUP**
 - ELECTRONICS REPORT APR 1989
 - MECHANICAL REPORT SEP 1989
 - CALS REQUIREMENTS TO SUPPORT CONCURRENT ENGINEERING MAR 1990
 - OO DEFENSE MANUFACTURING BOARD
 - INDUSTRY ACTIONS MAR 1990
 - DOD ACTIONS

CONCURRENT ENGINEERING

STATUS SUMMARY (CON'T)

- IMPLEMENTATION
 - oo ARMY
 - ACQUISITION CENTER
 - LHX
 - oo AIR FORCE
 - R&D
 - ACQUISITION PROCESS
 - ENGINEERING PROCESS STANDARDS
 - ATF, ALS
 - oo NAVY
 - DOD TRANSITION TEMPLATES
 - oo INTERIM ACQUISITION GUIDELINES USD(A)

VISION

- REDUCED DEVELOPMENT CYCLE BY HALF
- ACHIEVES HIGH QUALITY/LOWER COST PRODUCTS
- THROUGH:
 - STREAMLINED PROCESSES
 - MULTIDISCIPLINE TEAMS
 - INTEGRATED DESIGN OF PRODUCT AND PROCESSES
 - PRODUCT/PROCESS OPTIMIZATION
 - PRODUCT DEFINITION
 - PAPERLESS PROCESSES FOR:
 - COMMUNICATION
 - ANALYSIS AND SIMULATION
 - DESIGN RELEASE
 - TRANSFER TO MANUFACTURE
 - RAPID MOCKUPS AND PROTOTYPES

9-0371

"THERE'S A WAY TO DO IT BETTER.

FIND IT."

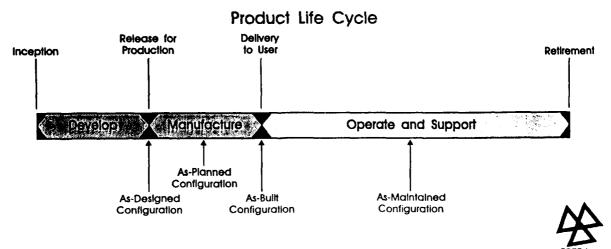
Thomas A. Edison



Mr. Robert Kiggins

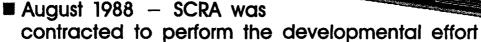
Product Data Exchange Specification (PDES)

PDES will provide a complete, unambiguous, computer interpretable definition of the physical and functional characteristics of each unit of a product throughout it's life cycle



Background

- Mid 1984 Work began on the PDES standard by the voluntary IGES/PDES Organization
- 1987 Industry interim PDES Executive Board formed
- April 1988 Several major technology companies incorporated as PDES, Inc.







Significance Of PDES

- PDES is a major Computer Aided Acquisition and Logistics Support (CALS) building block
- As a standard method for digital product definition PDES will enable:
 - Communication among heterogeneous computer systems
 - e.g., Government (*) Industry industry (*) Industry

Industry (Suppliers

- Integration of manufacturing functions/processes
 - e.g., Design ** Manufacturing
 Design ** Design Analysis
- Automatic, paperless updates of system documentation (engineering drawings, technical manuals, etc.)



Overall Program Objectives

"Joint Industrial/Government Effort To Accelerate Product Data Exchange Specifications (PDES) Development And Implementation"

- Gain acceptance of the Information definition in a standard information specification
- Accelerate implementation of technologies pertinent to the delivery and interpretation of such product definition information in heterogeneous computer environments

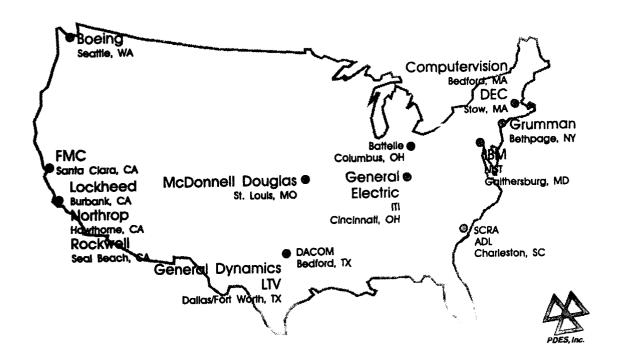


Member Companies Member Companies as of December '88

Class 1	Class II				
Boeing General Dynamics General Electric Grumman Lockheed McDonnell Douglas Northrop IBM	LTV Rockwell Computervision DEC FMC				



PDES, Inc. Team

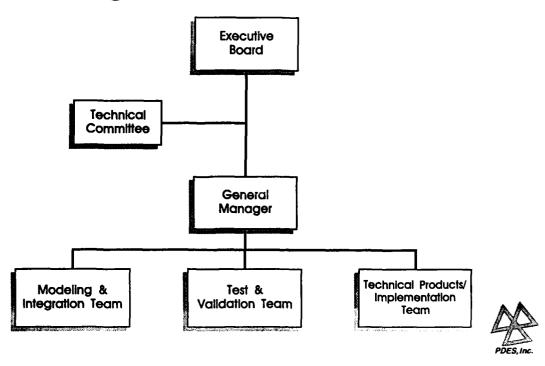


Technical Approach

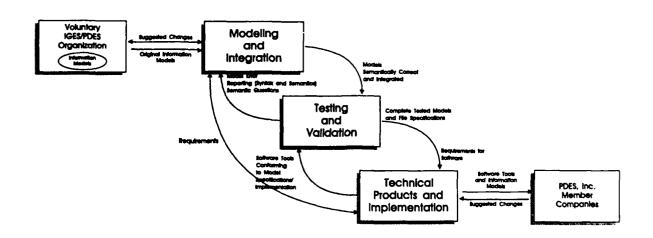
- Use initial PDES drafts of volunteer IGES/PDES Organization as baseline
- Concentrate on completing, integrating testing and validating existing PDES data models
- Focus on data exchange implementation using data base technology as method for testing information models



Organizational Structure



Technical Team Interface





Phase I Master Schedule

	gy 88	OCI	ğ	SEC.	S S	FEB	MAR	APR	MAY	NOT	₹	AUG	8₹	8	ğ	ည္ဆ	₹8	FEB	₩	₹
Phase i																				
Tech Devel Plan																				Į
Modeling & Integration												•						ĺ.,		
Test & Validation																				
Technical Products												-								l
Phase I Release																				
			•]										1						
Phase II					i .							1			ŀ					
Tech Devel Plan (Draft)																				

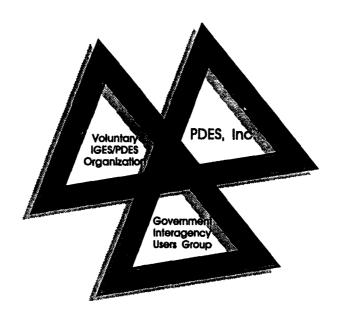


Risk Management

Risk Area	Risks	Risk Reduction					
Technical	Baseline models untested/incomplete Technical team inexperienced with PDES models Software tools limited and quality unknown Testing methodology not well understood	Technical team assigned to review/integrate models Ongoing IDEFIX/Express workshops for member technical labor Technical team to support software tool acquisition/development Testing/validation team focused on testing methodologies					
Management	Geographic dispersion Motivation and control Dependence on voluntary organization High dependence on PDES National Testbed	Maximum utilization of communications Emphasis on increasing stature of program Yearly evaluation reports MOU signed with NIST Testbed Group Draft MOU coordination with voluntary IGESPOES Organization and Navy					
Schedule	Phase I = 18 months Concurrent testing/multiple releases Concurrent testing/implementation approach	Tracking WBS Prioritized scope Fieldble release schedule Close coordination between teams Rigorous software development methodology					
Resource	Initial program based on 20 Class I members/40 technical resources Resources, in some cases, are "equivalent" resources.	Prioritized scope Team leaders Manhour tracking by month Companies assume area responsibilities after inflat baseline allocation					



Program Interaction



PDES Interaction

- PDES, Inc.
 - Develop and demonstrate a pregmatic implementable specification for product data

PDES, In

- Industry funded
- Government Intergreency Wisers Group
 - Coordinate Dab and other agency implementation
 - Common interface with industry
 - National PDES testbed supportioner
- Voluntary IGES/PDES proanization
 - Volunteer effort by users, Vendors to define current PDES baseline
 - NIST coordination of standardization efforts



Membership

Class 1 Membership

\$100,000 dues and 2 man-years of technical effort yearly

Class 2 Membership

■ \$50,000 dues and 1 man-year of technical effort yearly

Class 3 Membership

\$25,000 dues yearly – no technical effort required

Government Associate

Dues and technical participation – as determined by the board

- Non-labor expenses up to a limit of 50K/year including:
 - travel
 - per diem
 - relocation
 - housing (if applicable)
 - computing support (while working at home location)
 - training of member company personnel



Benefits Of Membership

- Influence the implementation of an emerging U.S. and International standard
- Obtain hands-on experience using PDES
- Gain a head start on competitors in preparing for compliance with the U.S. DoD CALS requirement



CALS Expo '88 Remarks

The Assistant Secretary of Defense for Production & Logistics stated:

"I would like to commend inclustry to its initiative in creating a product date exchange specification cooperative — PDES, Inc.

I encourage you to learn more about this effort...

I would think that there would be a rush to join — it will be increasingly so when more companies recognize that CALS/PDES has the potential for providing a competitive advantage."

PDES, Inc.



National PDES Testbed

Cita M. Furlani

National Institute of Standards and Technology



Major Functions of Testbed

Automated Research Library

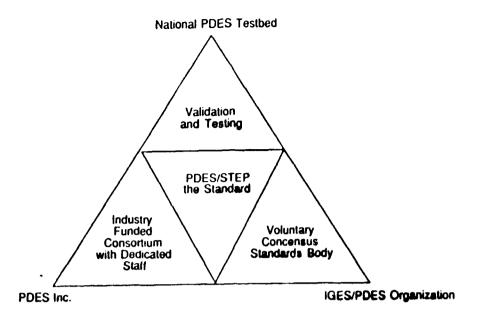
Test Facility

Demonstration Facility

Network of PDES Testbeds



Organizational Relationships





Automated Research Library - Goals

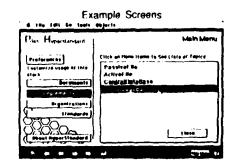
To provide a sharing of knowledge and/or experience.

To apply state-of-the-art technology to resolve the ancillary issues that are slowing the development of PDES.



PDES Hyperstandard

- An application of hypertext technology to PDES
- Official LaTeX formatted documents are parsed automatically into screen views
- Implemented using HyperCard on Macintosh
- Tutorial and related documents may also be made accessible through a consistent user interface
- Placement of document onto a CD-ROM will allow for the storage of large quantities of information that can be accessed using these techniques.







Information Clearinghouse will provide:

A central location accessible over electronic networks

All PDES-related papers, cataloged

PDES-related papers, models, and supporting documents in electronic form

A Hyperstandard (hypertext version of PDES information)

Provide repository of relevant standards

Provide database of major projects related to PDES



Configuration Control provided for:

Two categories
Machine readable
Machine interpretable

Three organizations (presently) IGES/PDES Organization ISO/TC184/SC4 PDES, Inc.



Configuration Items

Draft Proposal

Information models and supporting documentation

Physical file and mappings

Test suites

Software tools for testing

Implementation software



Configuration Control - Tools

CMS (VAX/VMS)

SCCS (Unix-based hardware)

PPDM (Tandem)

IRDS-supported Dictionary Meta-model



Configuration Control - Dictionary Meta-Model

A conceptual model describing the documents and other conceptual models that are part of PDES

Uses the extensibility of IRDS

Provides a means for configuration control of PDES documents and information models

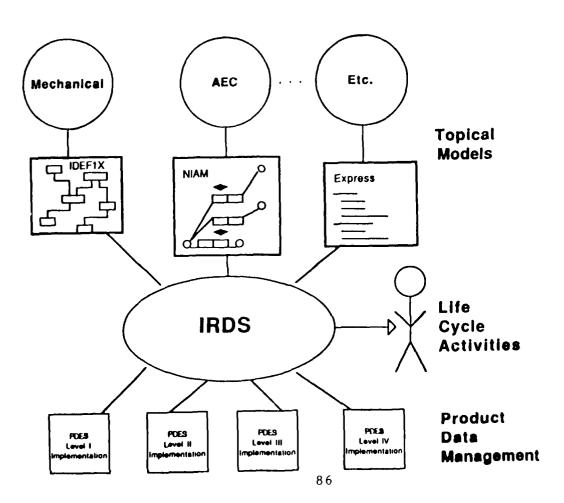
Will become the central tool for managing PDES information



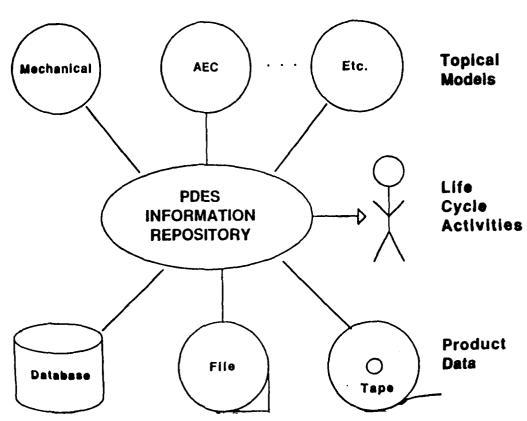
IRDS (Information Resource Dictionary System)

- ·An ANSI standard for data dictionaries
- Its extensibility is being used to define a PDES Dictionary Meta-Model
- ·Can support the three schema architecture approach
- •Provide a uniform mechanism for the storage of all PDES information models
- •Supports the integration process by merging development and maintenance tools into one environment











Why Do We Need A Testbed?

To identify potential problems and serve as an arbitration mechanism to decide what is the "correct" interpretation of the specification.

To lead the way in using PDES data in experimental environments.

To demonstrate the practicality of the data in an operational environment.



Test Facility - Goals

To provide a forum for the development of techniques to validate and ensure the internal consistency of the specification.

To provide a place where particular instances of products can be fabricated and tested using a set of metrics.

To develop a program for conformance testing of implementations of PDES.



Loans or Donations

Prime/Computervision: CAD/CAM systems

Tandem: VLX system and software

Dacom: LEVERAGE

Control Data: PC-PRECISE

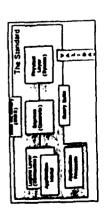
Case Consulting: Dynamod

Oracle: Oracle

Ontologic: Vbase

Serviologic: Gemstone

Graphael: Gbase



Validation

Validation

The process of evaluating the specification against general design requirements.

Application Protocols

Provide a framework to perform validation of specification.

Data Dictionary

Configuration Control

Semantic Consistency

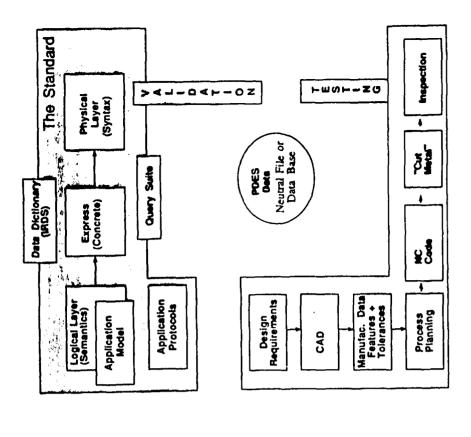
Source of information models

Query Suites

A set of requirements for information required by the specified application.

Can be used to exercise reference path analysis to determine the completeness of the conceptual information model.

Domains of Validation and Testing



Four Pieces of an Application Protocol

Conceptual information model

A definition of the information required for an application.

Application protocol format specification

The particular entities to be used with particular restrictions on the values of their attributes.

Protocol usage guide

A user's guide for the modeling conventions and entity mappings.

Application protocol format test cases

Contair engineering product definitions from the application area. The test cases are complete and exercise all aspects of the information model.

Testing is the combined analysis and verification to take place in the act of pushing data through a processing chain to "cut some metal."

Testing Techniques

Pilot Applications

Ad Hoc Queries Instance Tables

Testing Systems

Design: An analysis of the design will verify the elements of the part which relate to the design requirements.

A geometric solid representation will be created and placed into a PDES representation Manufacturing Data: The feature and tolerances necessary for manufacturing will be added to the PDES data.

PDES features and toler-representation to generate Process Planning: Will use ances combined with the solid

machine tools will create a part.

NC Code: Specific NC code will be generated and the

inspection: The part will be inspected and compared to the design data.



Demonstration Facility - Goals

To establish the effectiveness and viability of PDES in the context of real world problems.

To establish a facility for giving demonstrations on all aspects of PDES technology as well as for providing work space for visitors.



Demonstration Facility

Demonstrate levels of implementation

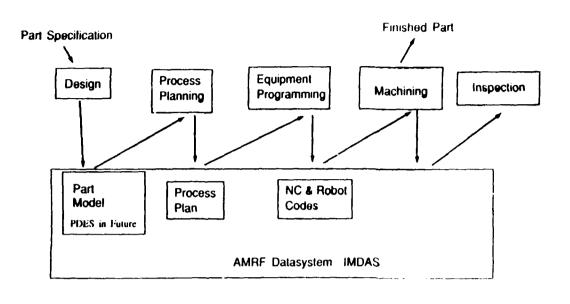
Laboratory provided for guest worker use

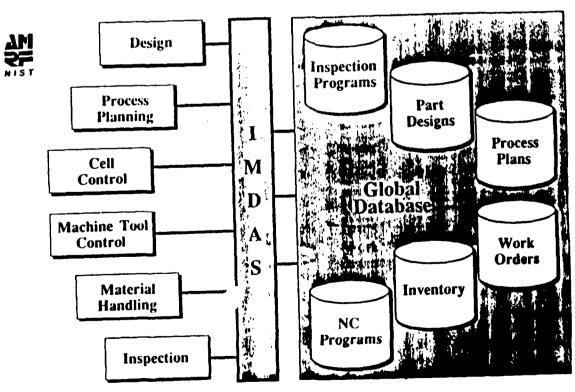
Experience base for understanding product data technologies

Utilizes Automated Manufacturing Research Facility



Demonstration Facility





Integrated Manufacturing Data Administration System

₹F

Features of IMDAS

- Operates on data stored in existing databases, front-ending them with common transaction and data interface
- Unified semantic network data model (SAM*) for the global conceptual schema
- Interface to programs via operations in string form, supporting controllers with arbitrary programming languages
- Modular distributed architecture with hierarchical control, allowing incremental growth
- Separation of control from data, allowing direct data flow from producer to consumer



Principal Data System Interfaces Areas for Standardization

- User program to Data Service command and status (Data Manipulation Language)
- User program to Data Service data input and output
- Distributed Data Server to Local Data Server command and status (interchange representation of transactions)
- Data Server to Data Server data input and output (interchange representation of data)



Important Standardization Efforts

- Relational Data Manipulation Language (SQL)
 - ANSI X3.135-1986
- Navigational Data Manipulation Language (NDL)
 - ANSI X3.133-1986
- Remote Database Access (RDA)
 - ISO dp
- Manufacturing Messaging Standard (MMS)
 - EIA IE31, Project 1393A, now ISO dp ??? in TC184/SC2
- Data Interchange Standards
 - ISO 8824 Abstract Syntax Notation One (ASN.1)
 - ISO 8825 Basic Encoding Rules
 - ISO 8211 Data Descriptive File (DDF)



Standardization Efforts Server to Server Data Interface

- Remote Database Access approach
 - couples data to command and status
 - defines interchange of relational tables only
- IMDAS Approach
 - separates data from command and status
 - data routing is directed by commands
 - defines interchange of "generalized relations": arbitrarily nested tables with set datatypes and structured datatypes
 - provides syntax with the data in interchange form



Network of PDES Testbeds - Goals

To test all aspects of PDES

To provide demonstrations of all aspects of PDES



National Testbed Network

- No single testbed will be capable of testing all PDES applications
- •Group tests will be necessary to ensure complete testing
- •Establish organizational and technical connections to other PDES testbeds
- •For Example:

CTN: CALS Test Network
Lawrence Livermore National Laboratory
SCRA: South Carolina Research Authority



Summary

Automated Research Library

Test Facility

Demonstration Facility

Network of PDES Testheds



Computer-Aided Acquisition and Logistic Support

COMPETITIVE GATEWAY TO Dod Contracting

BRUCE LEPISTO
OFFICE OF THE SECRETARY OF DEFENSE

THE PROBLEM

- ACHIEVE INDUSTRIAL PROCESS IMPROVEMENT
- IMPROVE WEAPON SYSTEM ACQUISITION COST, QUALITY, AND SCHEDULE
- ACCOMPLISH WITHIN FREE ENTERPRISE CONSTRAINTS
- ACHIEVE SHORT TERM GAINS THAT LAY THE FOUNDATION FOR LONG TERM IMPROVEMENTS

DOD POLICY

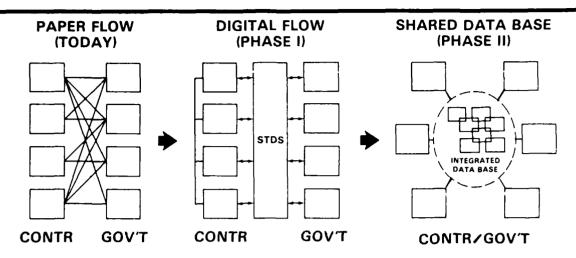
- DOD DIRECTIVE 5000.1: MAJOR SYSTEM ACQUISITION
 - READINESS IS A PRIMARY OBJECTIVE OF THE ACQUISITION PROCESS EQUAL IN IMPORTANCE TO BOTH PERFORMANCE AND SCHEDULE
 - "SUPPORTABILITY SHALL BE A DESIGN REQUIREMENT AS IMPORTANT AS COST, SCHEDULE AND PERFORMANCE..."
- DOD DIRECTIVE 5000.39: ACQUISITION AND
 MANAGEMENT OF ILS FOR
 SYSTEMS AND EQUIPMENT
 - THE OBJECTIVE OF ILS IS TO ACHIEVE AND SUSTAIN SYSTEM READINESS AT AN AFFORDABLE LIFE CYCLE COST (LCC)

THE SCOPE OF CALS

CALS IS NOT JUST LOGISTICS

CALS IS -DESIGN
ENGINEERING
MANUFACTURING
PRODUCT SUPPORT

WHAT IS CALS?



- INTEGRATION PROGRAM
- TRANSITION TO "NEAR PAPERLESS" DESIGN, MANUFACTURING, SUPPORT
- GAIN BENEFITS OF A HIGHLY AUTOMATED AND INTEGRATED SYSTEM

PROCESS LEVERAGE POINTS

- LONG TERM, HIGH PAYOFF
 - •• REQUIREMENTS, ENGINEERING
 - -- DETERMINE 90% OF COST, 50% OF SCHEDULE
 - •• NON-TOUCH
 - -- 70% LABOR
- SHORT TERM, MODERATE PAYOFF
 - •• FABRICATION PROCESSES
 - -- LABOR AND MATERIAL

BENEFITS-EXAMPLES

- AUTOMATION OF FUNCTIONS
 - .. MORE EFFICIENT PREPARATION & DELIVERY
 - -- 20-30% SAVINGS IN TECH MANUAL AUTHORING
 - -- 35% IMPROVEMENT IN TROUBLESHOOTING ACCURACY
- INTEGRATED DATA BASES
 - •• 20-35% SAVINGS IN ILS
- REDESIGNED PROCESSES
 - •• 20% ESTIMATED SAVINGS OVER SYSTEM LIFE CYCLE

THE CIM VISION

- FACTORY OF THE FUTURE RUN BY ROBOTS
- COMPATIBLE HARDWARE AND SOFTWARE PRODUCTS
- PAPERLESS OFFICE
- UNIVERSAL DATA STANDARDS
- FLEXIBILITY WITH LOW IMPLEMENTATION COST
- REAL-TIME COMPLIANCE WITH BUSINESS OBJECTIVES

THE CURRENT CIM REALITY

- ADVANCED MANUFACTURING TECHNIQUES FOR INDIVIDUAL PROCESSES
- ISLANDS OF AUTOMATION
- INCOMPLETE AND INCONSISTENT DATA COMMUNICATIONS
- LACK OF INFORMATION TECHNOLOGY STRATEGY
- LACK OF SUITABLE ENGINEERING DATA BASE
- LACK OF SUITABLE PLANNING METHODOLOGY

CALS POLICY INITIATIVE (DepSecDef MEMO, 24 Sep 1985)

OBJECTIVES

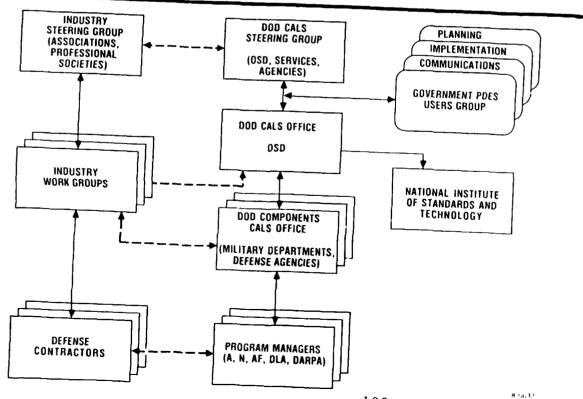
- ACCELERATE INTEGRATION OF R&M DESIGN TOOLS INTO CONTRACTOR CAD/CAE SYSTEMS
- AUTOMATE CONTRACTOR PROCESSES FOR GENER-ATING LOGISTIC TECHNICAL INFORMATION
- RAPIDLY INCREASE DoD CAPABILITY TO RECEIVE, DISTRIBUTE, AND USE TECHNICAL INFORMATION IN DIGITAL FORM
 - -- BY 1990, NEW MAJOR WEAPON SYSTEMS WILL ACQUIRE TECHNICAL INFORMATION IN DIGITAL FORM

CALS IMPLEMENTATION POLICY

DEPSECDEF MEMO

- SYSTEMS NOW IN FSD OR PRODUCTION
 - REVIEW COST SAVING AND QUALITY OPPORTUNITIES FROM CHANGING TO DIGITAL DELIVERY OR ACCESS
- SYSTEMS ENTERING DEVELOPMENT AFTER SEP 1988
 - REQUIRE PROPOSALS FOR CALS DATA DELIVERY OR ACCESS
- INFRASTRUCTURE SYSTEMS
 - PROGRAM RESOURCES FOR SYSTEMS TO RECEIVE AND USE DIGITAL DATA
 - CONFIGURE OR ADAPT SYSTEMS TO SUPPORT CALS STANDARDS
- ACQUISITION POLICY
 - USD(A) WILL ISSUE FURTHER GUIDANCE ON CONTRACTING, INCENTIVES, SUBCONTRACTORS, FUNDING MECHANISMS.

CALS MANAGEMENT ORGANIZATION



102

SERVICE AND DLA PROGRAMS

TECHNOLOGY

- ADVANCED INFORMATION INTEGRATION
- PARTS DATA ACCESS
- ELECTRONIC TECHNICAL MANUALS
- R&M DESIGN INTEGRATION

INFRASTRUCTURE

- PLANNING AND ARCHITECTURE
- ENGINEERING DATA REPOSITORIES
- COMPUTER-AIDED DESIGN
- AUTOMATED TECH MANUALS
- INTEGRATED WEAPON SYSTEM DATA BASE

8-3824

CALS PROGRAM AT NIST

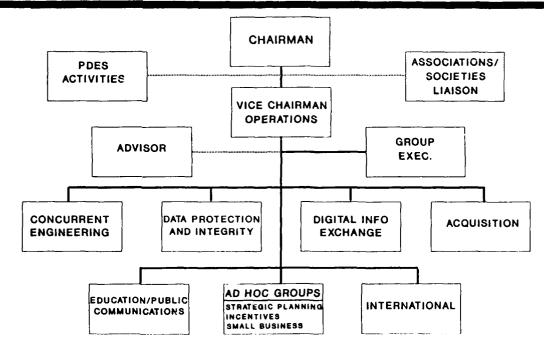
MAJOR AREAS OF SUPPORT

- STANDARDS AND CONFORMANCE TESTS
- PLANNING AND MANAGEMENT SUPPORT
- NATIONAL PDES TESTBED

PRIORITY ITEMS IN FY 1989

- LSAR INFORMATION MODEL & DATA DICTIONARY
- FUNCTIONAL SPEC FOR CONTRACTOR INTEGRATED TECHNICAL INFORMATION SYSTEM
- EDI TRANSACTIONS FOR CALS
- OTHER PHASE 1.2 ADDITIONS TO CALS STANDARDS -- ELECTRONICS, PAPERLESS TM's, ...
- CONFORMANCE TESTS FOR PHASE I STANDARDS

INDUSTRY STEERING GROUP (ISG)



CALS STRATEGY

STANDARDS AND INTEGRATION REQUIREMENTS
Develop and test standards for digital technical data
interchange. Define functional integration requirements.

WEAPON SYSTEM APPLICATION

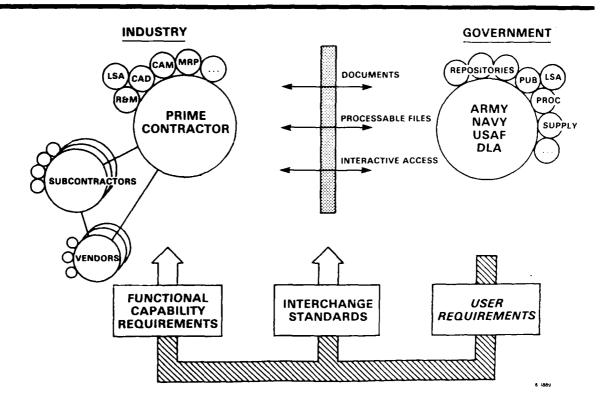
Implement CALS requirements in weapon system contracts. Encourage industry investments, process improvements.

TECHNOLOGY

Sponsor technology development and demonstrations for integration of technical data bases, and for design, manufacturing, and support applications.

DOD AUTOMATED INFORMATION SYSTEMS Implement CALS standards and integration requirements in DoD infrastructure modernization and architecture planning.

DIGITAL INFORMATION EXCHANGE



ACQUISITION AND LOGISTICS DATA PRODUCTS

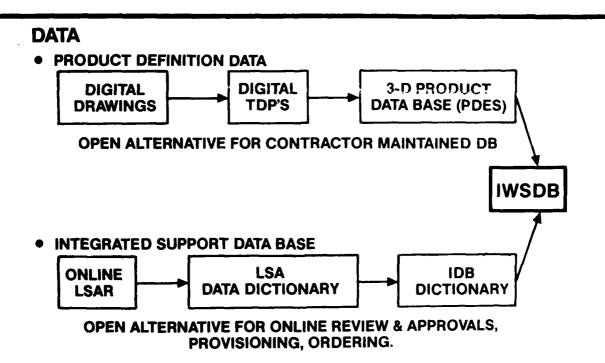
- ENGINEERING DRAWINGS
- TECHNICAL MANUALS
- ENGINEERING ANALYSES
- LOGISTIC SUPPORT ANALYSIS DATA
- TECHNICAL REPORTS
- PROVISIONING DATA
- TRAINING MATERIALS
- INTEGRATED LOGISTIC SUPPORT PLANS

EVOLVING CALS TECHNOLOGIES

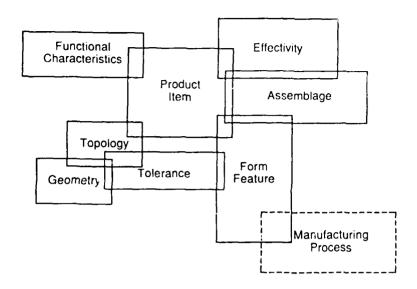
	CURRENT	NEAR TERM	LONGER TERM
• TECH MANUALS	• PAPER	PRINT ON DEMAND ELECTRONIC PAGE TURNERS	 INTELLIGENT INTERACTIVE MAINT AIDS
ENGINEERING DWGS	APERTURE CARDS	RASTER SCAN LIMITED VECTOR TRANSFER	COMPLETE DIGITAL PRODUCT MODEL
LOGISTIC SUPPORT ANALYSIS	• 1388 LSAR TAPE	CONTRACTOR-SPECIFIC ONLINE ACCESS	NEUTRAL QUERY OF HETERO- GENEOUS SYSTEMS

7 0623

CALS MAJOR THRUSTS



PDES Integrated Model - Version 1



PDES DEVELOPMENT PRODUCT DATA EXCHANGE SPECIFICATION

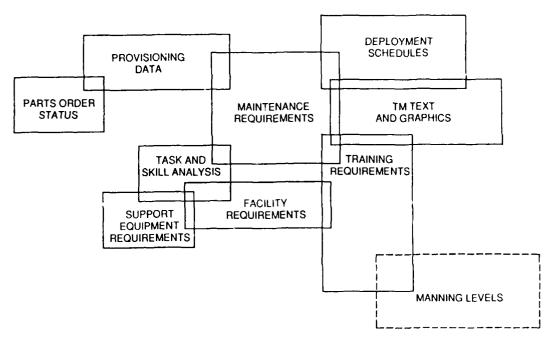
IMPORTANCE TO CALS

- LOGICAL STRUCTURE FOR PHASE II SHARED DATA BASE
- EXPANDS POSSIBILITIES FOR INDUSTRIAL NETWORKING

KEY PLAYERS

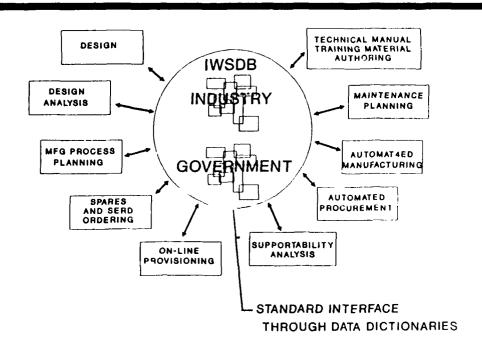
- IGES/PDES STANDARDS ORGANIZATION
- PDES, INC
- NATIONAL PDES TESTBED (NIST)
- GOVERNMENT PDES USERS GROUP

INTEGRATED SUPPORT DATA BASE



CALS '88 Priorities Presentation 2/2/88

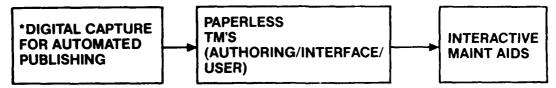
PHASE II INTEGRATION TARGET INTEGRATED WEAPON SYSTEM DATABASE (IWSDB)



CALS MAJOR THRUSTS

APPLICATIONS

• TECHNICAL MANUALS

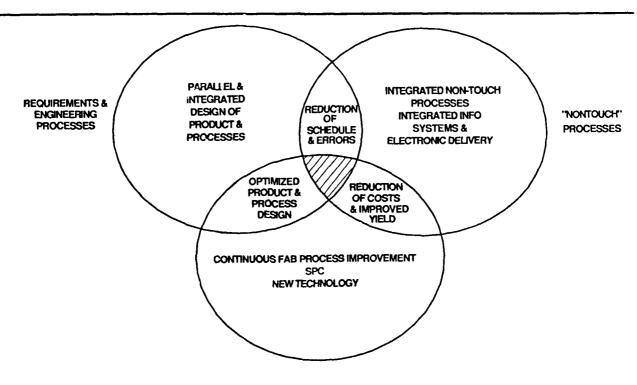


OPEN ALTERNATIVE FOR ELECTRONIC PRESENTATION OF EXPERT SYSTEM TROUBLESHOOTING ROUTINES

- SPARES ACQUISITION
- TRAINING MATERIALS
- OTHERS

8 10.24

POWER OF INTEGRATION



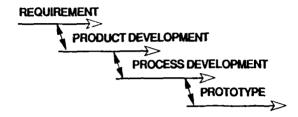
FABRICATION PROCESSES

CONCURRENT ENGINEERING

SEQUENTIAL ENGINEERING

REQUIREMENT PRODUCT DEVELOPMENT PROCESS DEVELOPMENT PROTOTYPE

CONCURRENT ENGINEERING



AN INTEGRATED PROCESS WHICH ENGINEERS THE PRODUCT AND THE MANUFACTURING AND SUPPORT PROCESSES TOGETHER WITH EMPHASIS ON EFFICIENCY, INCREASED QUALITY AND REDUCED COST.

CALS STANDARDS CONCEPTS

- ANNUAL INCREMENTS
- ADDITIONS & EXTENSIONS, NOT CHANGES
- INCORPORATE EVOLVING TECHNOLOGY
- IMPLEMENTATIONS OF INTERNATIONAL INDUSTRY STANDARDS
- JOINT INDUSTRY-DoD DEVELOPMENT

CALS STANDARDS TYPES AND RESPONSIBILITIES

CATEGORIES SOURCE

FUNCTIONAL REQ'TS FUNCTIONAL MGRS

DATA INTERCHANGE CALS - PHASE I

DATA MGT & ACCESS CALS - PHASE II

COMMUNICATIONS NETWORK MGRS

APPLICATION GUIDANCE CALS

CURRENT CALS STANDARDS

DoD STANDARD	DATE	NAT'L/INT'L STANDARD	APPLICATIONS				
MIL-STD-1840A	DEC 87	-	DATA INTERCHANGE/FILE MANAGEMENT				
MIL-D-28000	DEC 87	IGES	CAD, VECTOR GRAPHICS - ENG DRAWINGS - TM ILLUSTRATIONS - NC MACHINING				
MIL-M-28001	FEB 88	SGML	AUTOMATED PUBLISHING - TECHNICAL MANUALS				
MIL-R-28002	DEC 88	CCITT 4	RASTER SCANNED IMAGES - ENG DRAWINGS - TM ILLUSTRATIONS				
MIL-D-28003	DEC 88	ССМ	VECTOR GRAPHICS - TM ILLUSTRATIONS				
MIL-HDBK-59	DEC 88	-	IMPLEMENTATION GUIDE - MODEL SOWS, CDRLS				

1989 CALS STANDARDS

MIL-STD-1840A EXTENSIONS

- EDIF, IPC, VHDL APPLICATION FOR DESIGN OF ELECTRONIC PRODUCTS
- EDI TRANSACTION SET FOR TECHNICAL DATA

PRODUCT DEFINITION DATA

 MIL-D-28000 (IGES) 3-D PIPING/TUBING APPLICATION

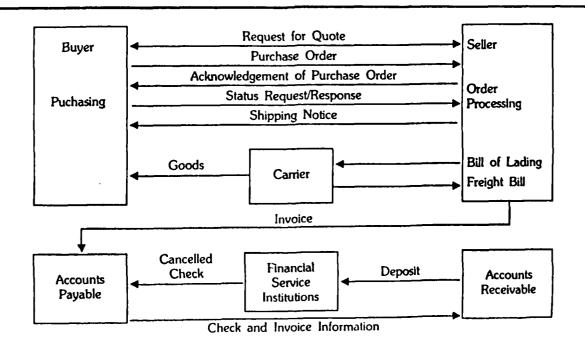
MIL-STD-1388-2B STANDARDS

- LSAR RELATIONAL DBMS IMPLEMENTATION
- IDEF DATA MODEL AND SQL APPLICATION

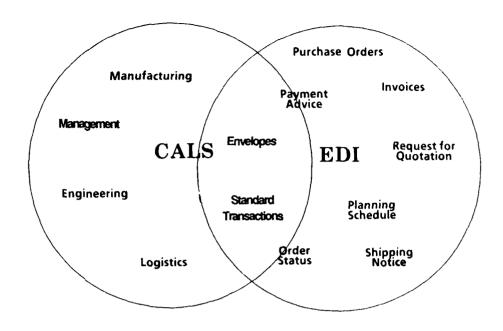
AUTOMATED PUBLISHING AND PAGELESS TECH MANUALS

- MIL-M-28001 EXTENSIONS DTD's AND OS's
- PTM AUTHORING, DATA INTERCHANGE, DELIVERY

Electronic Data Interchange (EDI)



CALS AND EDI



IMPLEMENTATION STEPS

PUBLISH STANDARDS

ADVANCE CONTRACTOR ROUTINE IMPLEMENTATION CONTRACTUAL DELIVERY

CONFORMANCE TESTING

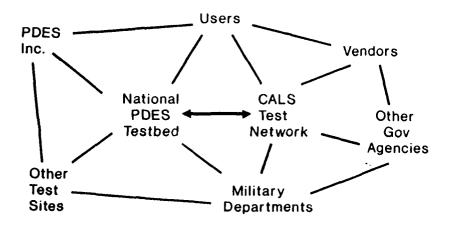
USER (END-TO-END) TESTING

INCORPORATION IN INFRASTRUCTURE SYSTEMS

CALS TEST NETWORK CTN OPERATION

- JOINT INDUSTRY-Dod PARTICIPATION
 - •• INDUSTRY & GOVERNMENT TEST NODES
 - •• GOVERNMENT CTN REVIEW BOARD
 - •• INDUSTRY CTN ADVISORY BOARD
- CTN 1989 ACTIVITY
 - •• PHASE I.O & PHASE I.1 STANDARDS USER/APPLICATION TESTING
 - •• PHASE I.2 DEMONSTRATIONS
 - •• CONFORMANCE AND ACCEPTANCE TEST PROGRAM PROTOTYPES

TEST NODE INTERFACES



NATIONAL PDES TESTBED

National Institute of Standards and Technology

- RESEARCH, DEMONSTRATION, AND TECH-NOLOGY TRANSFER
- DEVELOPMENT TESTING AND VALIDATION
- PDES CONFIGURATION MANAGEMENT
- INTEGRATION OF TOPICAL MODELS
- CENTRAL INFORMATION CLEARINGHOUSE

IMPLEMENTATION POLICY

IMPORTANT CONSIDERATIONS

- RECOGNIZE THAT INTEGRATION IS NOT AN "ALL OR NOTHING" PROPOSITION
 - See how far bidders can go
- ON-LINE ACCESS WILL BE LIMITED TO SELECTED CONTRACTOR DATA BASES
 - Principal targets are deliverables for review and approval
- ROUTINE DELIVERY OF DIGITAL DATA WILL BE PACED BY AVAILABILITY OF VALIDATED STANDARDS AND GOVERNMENT RECEIVING SYSTEMS
 - Define requirements now for data to be delivered in the 1990's
 - Seek flexible alternatives to hedge risks

BOTTOM LINE

- KEEP CALS TARGET IN SIGHT, BUT DO WHAT MAKES SENSE FOR EACH PROGRAM
- CALS LEAD PROGRAMS ARE GOOD EXAMPLES

CALS IMPLEMENTATION ISSUES

ACQUISITION COMMITTEE CHARTERED

- RIGHTS TO DATA
- SECURITY, PRIVACY, EXPORT CONTROLS
- PROFIT STRUCTURE, INVESTMENT INCENTIVES
- DELIVERY, VERIFICATION, ACCEPTANCE
- LEGAL LIABILITY
- CO-OPERATIVE PRODUCTION (OTHER NATIONS)
- DAR, FAR REVISIONS
- ADP ACQUISITION PROCESS

8.3834

CALS SCHEDULE OBJECTIVES

• STANDARDS • TESTING	1987 1988 1989 1990 1991 1992 1993 PHASE II ——————————————————————————————————
TECH DEV &DEMOS • TECH R&D • WS DEMOS	PLAN ONGOING SSN-21 ATF V-22 C-17 LHX
WEAPON SYS CONTRACTS • POLICIES • IMPLEMENTATION	IMP ACO/INCENTIVES CONTRACTS
DOD IMPLEMENTATION • PLANNING ARCHITECTURE • INFRASTRUCTURE MODERNIZATION	CAD INTEGRATED DB ELECTRONIC TECH MANUALS

MAJOR CALS WEAPON SYSTEMS

NAVY A-12 ATTACK AIRCRAFT

USAF B-2 STEALTH BOMBER

NAVY SSN-21 SEAWOLF SUBMARINE

USAF ATF ADVANCED TACTICAL FIGHTER

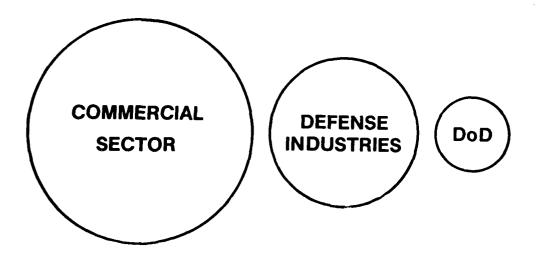
ARMY LHX LIGHT HELICOPTER

OVER 25 ADDITIONAL PROGRAMS ALREADY PROPOSED. OTHERS BEING STUDIED.

MANAGEMENT PRIORITIES

- STANDARDS AND INTEGRATION REQUIREMENTS.
 - •• SUFFICIENCY FOR ROUTINE USE
 - •• TAILORING FOR UNIQUE PROGRAM NEEDS
 - •• CONFORMANCE TEST AND CERTIFICATION
- WEAPON SYSTEM APPLICATION
 - •• EDUCATION FOR DoD AND INDUSTRY
 - •• INVESTMENT INCENTIVES
 - •• ARTICULATION OF BENEFITS
 - SUBCONTRACTOR FLOWDOWN
- TECHNOLOGY
 - •• TECHNOLOGY TRANSITION
 - •• DATA PROTECTION AND INTEGRITY
- DoD SYSTEMS
 - •• ARCHITECTURE AND INTERFACES
 - •• TARGET CAPABILITIES AND DATES

CALS MARKETS



8-3889

BENEFITS

FROM INDUSTRY'S PERSPECTIVE

- PRODUCTIVITY GAINS THROUGH AUTOMATION & INTEGRATION
 - LESS EFFORT IN DESIGN/MANUFACTURING TRANSITION
 - LESS REDUNDANCY IN DATA PREPARATION
 - PAPERLESS INTERCHANGE AMONG PRIMES, SUBS
- QUALITY IMPROVEMENTS
 - PRODUCT DESIGN
 - DATA

FROM GOVERNMENT'S PERSPECTIVE

- PRODUCTIVITY GAINS
 - ACQUISITION
 - OPERATION
- IMPROVED READINESS
 - SHORTENED LEAD TIMES
 - TIMELY, ACCURATE, ACCESSIBLE DATA

O-1000

THE DEPUTY SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

AUG 1988

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS DIRECTOR, DEFENSE LOGISTICS AGENCY

SUBJECT: Computer-aided Acquisition and Logistic Support (CALS)

To achieve productivity and quality improvements, my September 1985 letter on CALS set the goal of acquiring technical data in digital form (rather than paper) for weapon systems entering production in 1990 and beyond. We have now taken a major step toward routine contractual implementation. The Department of Defense (DoD) has coordinated with industry the first in a series of CALS issuances of national and international standards for digital data delivery and access. These standards have been published in MIL-STD-1840A, "Automated Interchange of Technical Information," and supporting military specifications. The CALS standards will enable either digital data delivery or government access to contractor-maintained technical data bases.

Effective immediately, plans for new weapon systems and related major equipment items should include use of the CALS standards. Specifically:

- o For systems now in full-scale development or production, program managers shall review specific opportunities for cost savings or quality improvements that could result from changing weapon system paper deliverables to digital delivery or access using the CALS standards.
- o For systems entering development after September 1988, acquisition plans, solicitations, and related documents should require specific schedule and cost proposals for: (1)-integration of contractor technical information systems and processes, (2) authorized government access to contractor data bases, and (3) delivery of technical information in digital form. These proposals shall be given significant weight for their cost and quality implications in source selection decisions. The CALS standards shall be applied for digital data deliverables.

DoD components shall program for automated systems to receive, store, distribute, and use digital weapon system technical information, including achieving the earliest possible date for digital input to DoD engineering data repositories. These systems shall be configured or adapted to support the CALS

standards. Plans for CALS implementation and productivity improvements will be addressed in Defense Acquisition Board and Major Automated Information System Review Council acquisition reviews, and in corresponding Service and Agency reviews.

Each application decision shall be made on its own merits with respect to the productivity and quality improvements expected at either prime contractor or subcontractor level. The Under Secretary (Acquisition) will issue further guidance on contract requirements, such as CALS options, in invitations for bid; opportunities and safeguards for small business and other vendors and subcontractors; government and contractor incentives; and funding mechanisms for productivity-enhancing investments in automation and CALS integration by defense contractors.

I believe that CALS is one of the most important and farreaching acquisition improvements we have undertaken. I would appreciate having the Assistant Secretary (Production and Logistics) receive your plan of action within 90 days, including identification of systems where opportunities exist for cost savings or quality improvement through application of CALS technology, the investment required to achieve these benefits, and proposed schedules for implementation.

Ulliam H. A. islinam H. Taft, IV

c: Under Secretary of Defense (Acquisition)
 Assistant Secretaries of Defense

AEROSPACE INDUSTRIES ASSOCIATION/DEPARTMENT OF DEFENSE PAGELESS TECHNICAL MANUAL STUDY GROUP

Ms. Mary Anne Thompson

JOINT DOD/INDUŞTRY CALS PAGELESS TECHNICAL MANUAL STUDY

Initially...

Three Active Working Groups Involved

- * Specifications & Standards Group
- * Communications Group
- * Implementation Group

None dedicated to technical publications!

CALS Pageless Technical Manual Study Group Chartered by OSD CALS Policy Office in Fall of '87

Objectives

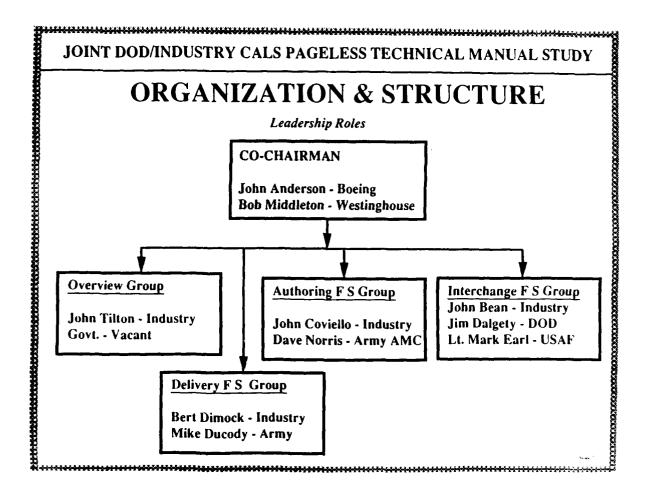
- 1. Develop recommendations for Generic Data Interchange Functional Specification
- 2. Develop Generic Authoring System Functional Specification
- 3. Develop Generic Delivery/Presentation System Functional Specification

JOINT DOD/INDUSTRY CALS PAGELESS TECHNICAL MANUAL STUDY

Study Group Membership

- * DOD
- * Army, Navy, and Air Force
- * Industry
 - Prime Contractors -
 - Subcontractors -
 - Vendors -
 - Other Interested Industry Disciplines -

Membership is competent and well qualified!



ACCOMPLISHMENTS TO DATE

- * Working Relationships Established
- * Expert Knowledge Available and Functioning
- * Concept Papers Complete
- * Generic Specifications 1st Drafts Complete

Results of Effort Will Provide:

- · Universal Authoring System
- Means to Eliminate Redundant Effort
- Government and Industry Compatibility
- Standardized Performance From Everyone
- Interservice Compatibility in Technical Data Preparation, Delivery, and Presentation
- Maximized Cost Effectiveness Throughout CALS

JOINT DOD/INDUSTRY CALS PAGELESS TECHNICAL MANUAL STUDY

SOME PROBLEMS WE FACE...

- * What is PTM Study Group's CALS Policy Office Charter Today?
 - Advisory?
 - Specification Developers?
 - or Both?
- * Near-term Need on A-12, ATF, and LHX Programs = Short-term Solutions
 - Separate Specifications Pursued by Navy and Air Force
- * Long-term Solution Benefits us All
 - "one face to industry"
 - Interchange specification ready for review
- * Contractors May Have to Support Multiple Authoring Systems

RECENT ACCOMPLISHMENTS...

- · Letter to CALS Policy Office
 - A-12, ATF, & LHX Program Timing -
 - TMSS Difficulty -
 - PTMSG has Drafts for MIL-M-28001 (Interactive Electronic Delivery) & Content Data Model Document Type Definition
- Drafts are Ready for Use on B-2, ATF, ATA, LHX, etc.
- · Industry Offers
 - to act as advisory group for near/short-term program requirements
 - continue to develop long-term generic functional specifications for paperless/pageless TMs
- Industry thinks DOD CALS Policy Office likes our offer
- Many Earlier Conflicts Resolved

..... 33

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

(Formerly the National Bureau of Standards)

The Development of MIL-STD-1840A And Other CALS Standards

David S. Bettwy
Center for Manufacturing Engineering
CALS Project Office

OVERVIEW



- The CALS Standards Process
- Standards in Place
- Standards in Development
- Future Plans

MIL-STD-1840A



■ MIL-STD-1840A -- Automated Interchange of Technical Information

 MIL-D-28000 -- Digital Representation for Communication of Product Data: IGES Application Subsets

■ MIL-R-280C2 -- Raster Graphics Representation in Binary Format: Requirements For

 MIL-D-28003 -- Digital Representation for Communication of Ilustration Data: CGM Application Profile

MIL-HDBK-59 -- CALS Implementation Guide

1840A DELIVERY FORMS



TECHNICAL PUBLICATIONS

- Tagged ASCII Text (SGML)
- Illustrations (CGM, Raster, IGES, Gray Scale)
- Published format control (PDL, OS)

PRODUCT INFORMATION

Product Data (IGES, Raster, EDIF, VHDL, IPC)

"ON-LINE" INFORMATION ACCESS

- Telecomunications (GOSIP)
- Distributed database standards & technology (IRDS, NDL, SQL, RDA)

1840A DELIVERY MEDIA



Magnetic Tape

(FIPS PUBS 1, 2, 25, 50, 79)

■ Telecomunications

(GOSIP, FIPS PUB 100)

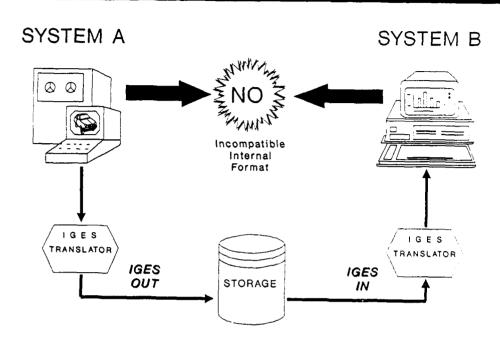
MIL-D-28000



- MIL-STD-1840A -- Automated Interchange of Technical Information
- MIL-D-28000 -- Digital Representation for Communication of Product Data: IGES Application Subsets
- MIL-M-28001 -- Markup Requirements & Generic
 Style Specifications for Electronic
 Printed Output & Exchange of Text
- MIL-R-28002 -- Raster Graphics Representation in Binary Format: Requirements For
- MIL-D-28003 -- Digital Representation for Communication of Ilustration Data: CGM Application Profile
- MIL-HDBK-59 -- CALS Implementation Guide

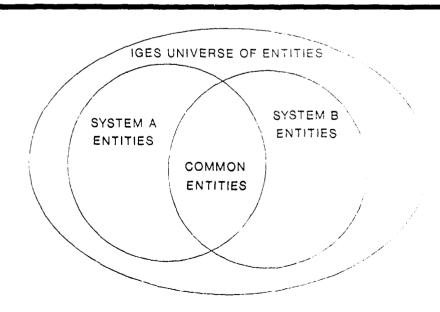
IGES NEUTRAL INTERCHANGE FORMAT



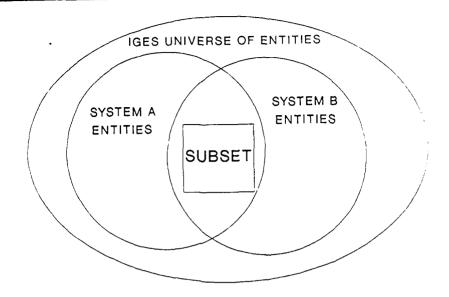


PURPOSE OF SUBSETS









MIL-D-28000 CONTENT



SCOPE

Specification of discrete subsets of IGES entities by functional area.

FUNCTIONAL AREAS

Class I Technical illustrations

Class II Engineering drawings

Class III Electrical/Electronic Applications

Class IV Numerical Control Manufacturing

Class V Piping and Tubing

MIL-D-28003



■ MIL-STD-1840A -- Automated Interchange of Technical Information

 MIL-D-28000 -- Digital Representation for Communication of Product Data: IGES Application Subsets

 MIL-M-28001 -- Markup Requirements & Generic Style Specifications for Electronic Printed Output & Exchange of Text

 MIL-R-28002 -- Raster Graphics Representation in Binary Format: Requirements For

 MIL-D-28003 -- Digital Representation for Communication of Ilustration Data: CGM Application Profile

• MIL-HDBK-59 -- CALS Implementation Guide

MIL-D-28003 (CGM)



"DIGITAL REPRESENTATION FOR COMMUNICATION OF ILLUSTRATION DATA: CGM APPLICATION PROFILE"

- Conformance to ANSI X3.122
- Entity ranges
- File inspection and acceptance criteria

MIL-R-28002



■ MIL-STD-1840A -- Automated Interchange of Technical Information

■ MIL-D-28000 -- Digital Representation for Communication of Product Data: IGES Application Subsets

MIL-M-28001 -- Markup Requirements & Generic
 Style Specifications for Electronic
 Printed Output & Exchange of Text

 MIL-R-28002 -- Raster Graphics Representation in Binary Format: Requirements For

 MIL-D-28003 -- Digital Representation for Communication of Ilustration Data: CGM Application Profile

■ MIL-HDBK-59 -- CALS Implementation Guide

MIL-R-28002 (RASTER)



SCOPE

Describes the binary digital representation of raster data, delivered in the CCITT Group 4, Recomendation T6, form.

FUNCTIONAL TYPES

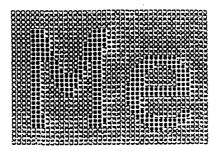
Type I -- Untiled Raster Image

Type II -- Tiled Raster Image

THE RASTER SCAN PROCESS



The initial image



RASTER DATA



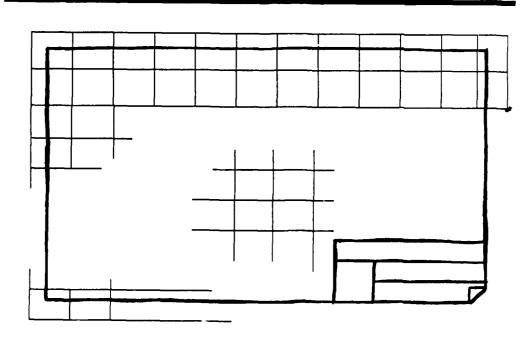
RASTER DATA COMPRESSION



							_						
Line				_		_	147	_		_		_	
No-	W	В	W	В	W	8	W	В	W	В	W	В	W
1	42												
2	42												
4	42 42 42 42												
1 2 3 4 5 6 7 8 9 10 11	4	3	10	3	22								
8		334445522222222222222223333	10 98 7 7 6 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		2222339442233445566779								
7	4	4	8	4	22								
8	4	4	7	5	22								
9	4 4 4	4	7	4 4 5 4	23								
10	4	5	6		23								
11	4	5	5	45223755322222343	9	7	7						
12 13	4	2	2	2	4	7 2 2 2 2 2 2 2 3 3 2 3 4 0 7	1	2	8	9	6		
13	4	2	2	2	4	2	1	2 2 2 3 3	8 7 6 7 7 7	4	3 5	4	5
14	4	2	2	3	2	2	1 2 6 6 5 5 5 5 5 5 1 5 5 5 7	2	6	4	5	4	5 4
15 16 17	4	2	2	7	2	2	6	3	7	3	4		
16	4	2	2	5	3	2	6	3	7	3 3 3	4 4		
17	4	2	2	5	3	2	5	4		3	4		
18	4	2	2	3	4	2	5	14 14	4				
19	4	2	2	2	4	2	5	14	4				
18 19 20 21	4	2	2	2	5	3	15						
2 1	4	2	2	2	5	3	15						
22 23	4	2	2	2	6	2	15						
23	4	2	2	2	6	3	8	2 3	4 4				
24	4	3	9	3	7	4	5	3	4				
24 25 26	4	3	9	4	7	10	5						
26	4	3	9	3	9	7	7						
27	4 29 42	3	10										
28 29 30	42												
29	4 2 4 2												
30	42												

RASTER IMAGE TILING





ELECTRONIC COORDINATION OF STANDARDS



PROBLEM

- Printing & distribution of review copies is time consuming and costly
- Preparing consolidated comments for review is time consuming and costly

PROPOSED SOLUTION

- Distribute the documents in a digital form on convenient media or by telecommunication
- Include a Database Maintenance application program to collect the comments in digital form, in a controlled format that allows the reviewer full use of their own word processor program

CALS ELECTRONIC BULLETIN BOARD



■ TWO LINES 301-948-7438 or 301-921-9842 300/1200/24000 BAUD

PURPOSE

- Electronic messaging system for CALS community
- Electronic file transfer
- Bulletins of meetings, conferences, workshops and other timely news
- References to major points of contact in CALS community
- Other on-line CALS and standards related information

UPDATE ON MIL-M-28001 ELECTRONIC PUBLISHING

Datalogics, Inc.

Ms. Pam Gennusa

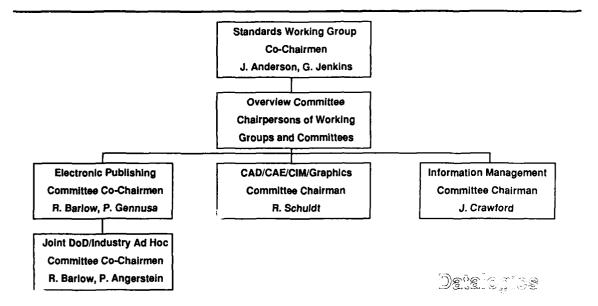
MISSION OF MIL-M-28001

Electronic Publishing for Paper Output

- Not for Electronic Retrieval
- This Controls "Depth of Tagging" (level of granularity & structure vs. content)

Extensible to Cover Variety of Technical Manual Document Types

MIL-M-28001 - CALS INDUSTRY STANDARDS WORKING GROUP ORGANIZATION



WHO SITS ON ELECTRONIC PUBLISHING COMMITTEE

Contractors Vendors Services OSD



MIL-M-28001A - SCHEDULE

Draft (complete) Due Out for Coordination Review - 11 JUL 89
Comments Due Back - +70 Days (20 SEP 89)
Resolution Meeting - +4-5 weeks (week of 30 OCT 89)
Final Release - DEC 89

Degar salas

MIL-M-28001A - MAJOR STRUCTURAL CHANGES

Specification Proper - Similar to Current Version Appendix A

- Information on Creating/Reading a DTD
- SGML Declaration
- General Purpose DTD Equivalent to Non-Conforming DTD;
 Uses All Elements in Baseline Tag Set
- Listing of Text Types

Appendix B

- Output Specification
- Guidelines for Using OS

MIL-M-28001A - MAJOR STRUCTURAL CHANGES - cont'd

Appendix C

- Entities Available for Use Across Applications

Appendix D

- MIL-M-38784 and Related Specifications DTDs
- Formatting Output Specification Instance (FOSI) for MIL-M-38784

Datalogics

WHAT'S COVERED IN SPECIFICATION PROPER?

Discusses Minimum Requirements for Delivery of an SGML Document Via MIL-STD-1840A

Discussion of Rules for Creation of Additional DTDs

WHAT IS A BASELINE TAG SET?

Interpret This as a Data Dictionary

One Agreed-Upon Name for Each Element

Descriptions Are Written, Natural-Language Explanations of Somewhat

Cryptic Nomenclature in the SGML DTD

Datalogics

WHAT ARE AN OS AND A FOSI?

Output Specification (OS)

- A finite Set of Style Characteristics to Convey Formatting Intent for Interchange of Technical Manuals
- A Mechanism for Binding Style Characteristics to Logical Elements in a DTD
- Current Version is Only Concerned with Paper Media

Formatting Output Specification Instance (FOSI)

- An Instance of the OS That Assigns Values to the Style Characteristics for a Particular DTD

Use SGML Syntax

Datalogics

MIL-M-28001A - AMENDMENT 1

List of Generic DTDs for Use Across All Services

- CALS Will Define and Publish DTDs & FOSIs That Relate to Common, Joint Set of Standards as Designed in MIL-STD-361
 - * Will Build on Work Being Done by Each Service (e.g., AFTOMS)
- High Priority for Services Identify Standards as Candidates for Coordination

Additional DTDs and FOSIs Included as Appendices E, F, G, etc. Due for Publication in 1990

Datalogics

CONCLUSIONS

High Level of Industry Involvement

- Aggressive Review Schedule Through CY89 to Complete MIL-M-28001A
- On-Going Activity Through CY89 on Next Amendment

Continued Coordination Between Services

- Continue Developing Complete Set of DTDs to Support Pending Procurements

MIL-STD-1388-2B AND JOINT SERVICE LSAR ADP REVISIONS

Mr. George Desiderio

OUTLINE

- o BACKGROUND ON THE LOGISTIC SUPPORT ANALYSIS RECORD-WHERE WE ARE NOW?
- o PROBLEM AREAS ENCOUNTERED WITH THE PRESENT MILITARY STANDARD (MIL-STD-1388-2A) AND ASSOCIATED JOINT SERVICES LSAR ADP SYSTEM.
- o THE DEVELOPMENT OF A REVISED STANDARD AND SOFTWARE SYSTEM.
- o MIL-STD-1388-2B, DOD REQUIREMENTS FOR A LOGISTIC SUPPORT ANALYSIS RECORD
 - WHAT ARE THE REQUIREMENTS?
 - THE RELATIONAL JOINT SERVICES LSAR ADP SYSTEM.
 - SCHEDULE FOR RELEASE OF THE STANDARD AND SOFTWARE.

BACKGROUND

- o MIL-STD-1388-2A RESULTED FROM A JOINT SERVICE EFFORT TO ESTABLISH A COMMON FORMAT FOR THE DELIVERY OF LSAR DATA.
- o ESTABLISHED IN JULY 1984 AS THE COMPANION DOCUMENT TO MIL-STD-1388-1A.
- O DIRECTED TOWARD IMPROVING COST EFFECTIVENESS OF THE GENERATION, MAINTENANCE, ACQUISITION AND USE OF TECH DATA TO SUPPORT ILS.
 - STD DATA ELEMENT DEFINITIONS AND FORMATS.
 - CONSOLIDATION OF LÓGISTICS ORIENTED DATA FROM ALL DISCIPLINES.
 - USE OF INTEGRATED DATA SYSTEMS TIED TO ENGINEERING AND MANUFACTURING DATA BASES.
- INCLUDED A GOVERNMENT DEVELOPED ADP SYSTEM TO AUTOMATE DATA STORAGE AND REPORTING.

WHERE WE ARE NOW

- MIL-STD-1388-2A, DOD REQUIREMENTS FOR A LOGISTIC SUPPORT ANALYSIS RECORD
 - DATA ENTRY INSTRUCTIONS
 - STANDARD OUTPUT SUMMARIES
 - MASTER FILES (FLAT FILE)
 - LCN, ALC, UOC ASSIGNMENT
 - APPLICATION & TRAINING GUIDANCE
 - DATA ELEMENT DICTIONARY W/OVER 600 LOGISTICS RELATED DATA ELEMENTS
- JOINT SERVICES LSAR ADP SYSTEM
 - FLAT FILE STORAGE OF DATA
 - BATCH MODE DATA INPUT VIA 80 COLUMN PUNCH CARDS
 - MAINFRAME ORIENTED
 - 80 STANDARD OUTPUT SUMMARIES
 - WRITTEN IN ANSI STANDARD COBOL
 - PROVIDED AS GFE UPON REQUEST
 - VALIDATION PROCESS FOR CONTRACTOR DEVELOPED SYSTEMS

PROBLEM AREAS

- o PRESENT ADP SYSTEM IS NEITHER FLEXIBLE NOR INTERACTIVE.
- REQUIRED MANY REDUNDANT DATA ENTRIES
- LIMITED DATA FIELD WIDTH
- o DIFFICULT TO INTERFACE WITH OTHER TOOLS OR DATA BASES.
- ORIENTED TOWARD MAINFRAME IMPLEMENTATION.
- DIFFICULT TO MAINTAIN BOTH THE MILITARY STANDARD AND THE SOFTWARE SYSTEM.

REVISION EFFORTS

- INITIAL EFFORTS TO DEVELOP A NEW STANDARD BEGAN ABOUT A YEAR AND A HALF AGO BY THE DOD LSA SPT ACTIVITY AND THE JOINT SERVICES LSA TECHNICAL WORKING GROUP.
- FORMATION OF A DOD LSA/CALS INFORMAL STUDY GROUP OCT 88.
- OSD NIST CONTRACT WITH BATTELLE/D. APPLETON CO. (30 NOV 88) TO PERFORM DATA MODELING.
 - IDEF1X MODELING TECHNIQUE
 - FUNCTIONAL AND TECHNICAL EXPERTISE PROVIDED BY LSA/CALS STUDY GROUP
- CALS/LSA MODELING RESULTS.
 - LOGICAL MODEL OF LSAR DATA
 - BUSINESS RULES
 - RELATIONAL TABLES

REVISION OBJECTIVES

- o DEVELOP AN EASILY MAINTAINABLE MILITARY STANDARD AND LSAR ADP SYSTEM THAT IS:
 - INTERACTIVE AND FLEXIBLE ON-LINE DATA ENTRY AND EDIT
 - CAPABLE OF INTERFACING READILY W/OTHER DATABASES
 - CAPABLE OF PROCESSING AD HOC QUERIES
 - PORTABLE ACROSS VARIOUS COMPUTER PLATFORMS AND PROPRIETARY SOFTWARE SYSTEMS
 - SUPPORTIVE OF A WIDER RANGE OF LOGISTIC PRODUCT REQUIREMENTS
- SUPPORT THE INITIATIVES IN THE CALS AREA.
 - REDUCTION IN REDUNDANT DATA ENTRIES
 - INTEGRATED DATA BASES
 - DIGITAL DELIVERY OF DATA

MIL-STD-1388-2B

- MAJOR CHANGE FROM MIL-STD-1388-2A.
 - REQUIREMENT FOR DATA TO BE DELIVERED IN RELATIONAL TABLE FORMATS INSTEAD OF FLAT MASTER FILES
 - ELIMINATION OF DATA INPUT RECORDS
 - ELIMINATION OF DATA ELEMENTS ASSOCIATED WITH CARD INPUTS
 - 83 ADDITIONAL DATA ELEMENTS FROM ACROSS FUNCTIONAL AREAS
 - ELIMINATION OF NON-PRODUCT ORIENTED OUTPUT SUMMARIES
- RELATIONAL BASED JOINT SERVICES LSAR ADP SYSTEM.
 - GFE WILL NOT INCLUDE THE PROPRIETARY RDBMS
 - PORTABILITY THROUGH EXPORT OF SQL
 - NOT DEPENDENT UPON PROPRIETARY RDBMS
 - COMPATIBILITY WITH MAINFRAME, MINI, MICRO APPLICATIONS
- VALIDATION PROCESS FOR COMMERCIAL SYSTEMS.
 - SIMILAR TO PRESENT PROCESS
 - NO REQUIREMENT FOR RDBMS TO MEET -2B REQUIREMENTS

MIL-STD-1388-2B CONTENT HIGHLIGHTS

- EXPANDS INDEPENDENT LSAR SOFTWARE VALIDATION REQUIREMENTS
 - •• DEFINES TYPE 2 AND TYPE 3 SYSTEMS (ELIMINATES TYPE 1)
 - •• REQUIRES CAPABILITY TO ACCEPT RELATIONAL TABLES AS INPUT
- LSA CONTROL NUMBER (LCN) FIELD EXPANDED TO 18 CHARACTERS
- LCN CAN REPRESENT HARDWARE OR FUNCTIONAL BREAKDOWN
- NEW LSAR REPORTS
 - CALIBRATION MAINTENANCE REQUIREMENTS SUMMARY
 - •• TRANSPORTABILITY REPORT
 - •• MANPOWER AUTHORIZATION REQUIREMENTS SUMMARY

MIL-STD-1388-2B DRAFT DOCUMENT FORMAT

1388-2A

1388-2B

LSAR DATA ENTRY INSTRUCTIONS

LSAR REPORTS (80)

LSAR MASTER FILES (FLAT FILES)

LCN, ALC, UCC ASSIGNMENT

APPLICATION & TAILORING

DATA ELEMENT DICTIONARY

DELETED (NO DATA RECORDS)

LSAR REPORTS (21)

RELATIONAL TABLE FORMATS

NO CHANGE

NO CHANGE

ADDED NEW DATA ELEMENTS

JSLSAR RELEASE 4 BENEFITS OF RDBMS

- ALLOWS FOR EASIER CHANGES TO DATA BASE STRUCTURE
- LSAR DATA CAN BE SHARED WITH OTHER FUNCTIONAL AREAS
- ONE-TIME STORAGE OF DATA ELEMENTS IMPROVES QUALITY AND CONSISTENCY OF PRODUCTS
- ALLOWS FOR AD HOC REPORT GENERATION
- MORE PRACTICAL FOR ON-LINE ACCESS

2B-REV-A

MIL-STD-1388-2B ADDITIONAL CONSIDERATIONS

- ALL CURRENT MIL-STD-1388-2A CONTRACTS AND SOFTWARE WILL CONTINUE TO BE SUPPORTED
- AUTOMATED CONVERSION ROUTINES WILL BE DEVELOPED TO ALLOW TRANSITION FROM MIL-STD-1388-2A FILES TO MIL-STD-1388-2B RELATIONAL FILES
- CONTRACTORS MAY USE ANY RELATIONAL SOFTWARE DEEMED DESIRABLE, BUT, MUST BE VALIDATED
- ADDITIONAL FUNCTIONAL AREA PRODUCT REQUIREMENTS WILL BE INCORPORATED AS STANDARIZATION IS ACHIEVED
- COMPANION DOCUMENT WITH IDEF1X DATA MODEL AND BUSINESS RULES WILL BE PUBLISHED CONCURRENT WITH MIL-STD-1388-2B

28-REV-8

CALS/LSA DATA MODELING PLANNED EFFORTS

- ACCEPTANCE TESTING OF CALS/LSA LOGICAL DATA MODEL (APR 89)
- ALPHA TESTING OF JSLSAR ADP SYSTEM RELATIONAL TABLES (MAY-DEC 89)
- BETA TESTING OF ADP SYSTEM PORTABILITY ISSUES (JUN-JUL 89)
- DEVELOP GUIDE CONTAINING CALS/LSA DATA MODEL AND BUSINESS RULES (DEC 89)

2B-REV-F

SCHEDULE

- MIL-STD-1388-2B
 PREPARE DRAFT AUG 88
 DATA MODELING 31 OCT 88 15 JAN 89
 STAFF DRAFT DOCUMENT 1 MAR 89 30 JUN PUBLISH 1 NOV 89
- JSLSAR ADP SYSTEM
 INITIATE SOFTWARE DEVELOPMENT 15 JAN 89
 TEST SOFTWARE 1 AUG 89 1 NOV 89
 DISTRIBUTE SOFTWARE 1 NOV 89

MIL-STD-1388-3B (PROPOSED)

- o A MILITARY STANDARD OR SPECIFICATION THAT DEFINES A MORE ADVANCED IMPLEMENTATION OF THE LSAR.
 - INTERACTIVE ACCESS OF DATA USING IDENTICAL SQL QUERIES
 - DATA SHARING ACROSS AUTOMATED INFORMATION SYSTEM BOUNDARIES
- o REQUIREMENTS FOR THE LSAR ADP SYSTEM STRUCTURE THAT CAN BE MAPPED TO THE IDEF1X MODEL USED TO DEVELOP MIL-STD-1388-2B. MIL-STD-1388-3B WILL CONTAIN.
 - IDEF1X DATA MODEL
 - SQL DATA DEFINITION LANGUAGE
 - BUSINESS RULES
- o STATUS -- CURRENTLY IN DISCUSSION PHASES ONLY.

CALS Test Network:

Verification and Application Testing Strategy

Melvin S. Lammers
Director, DoD CALS Test Network
Chief, Office of Technology Support, AFLC LMSC/SJT

Outline of Briefing

- CTN Objectives
- End-to-End Testing Defined
- Test Schedules
- Benefits of Testing

CALS Test Network (CTN) Goal

Test and Demonstrate CALS Standards

Digital Technical Information

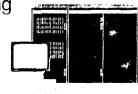


RECEIPT

Objectives I

- Develop Distributed Testing Capability
 - Develop Software/Test Platforms
 - Identify Industry/Government Participants
 - Establish CTN Review/Advisory Boards
- Demonstrate Complete Data Delivery Process
 - Determine Functionality/Tech Capability
 - Manage User/Application Testing





حلات ا

Objectives II

- Evaluate Effectiveness of CALS Standards
 - Identify Needed Improvements
 - Prototype Conformance/Acceptance Tests
- Evaluate New Technology
 - Identify Requirements for New Standards
 - Identify Useful CALS Technologies

CTN ATTRIBUTES

- Focus on User Testing
 - CTN Planned Test (CPT)
 - Independently Planned Test (IPT)
- Demonstrate Effectiveness and Benefits
- Maintain Communication Network and Data Base
- Feedback to Standards Process and Vendor Implementations

MIL-STD-1840A Envelope Std

MIL-STD-1840A: Is a standard which specifies the general format for computer tape transmission of digital technical data, and points to other necessary standards.

Used to package the digital technical manuals, or engineering drawings, for exchange between systems in industry or DOD.

Example: Exchanging a file of technical manuals between Lockheed and the Air Force

6 Jan 1989

MIL-D-28000

MIL-D-28000: Subsets of the Initial Graphics Exchange Standard (IGES). IGES is a national standard for neutral formatted vector graphics

Used to exchange engineering drawings & illustrations between dissimilar CAD/CAM systems and engineering data repositorities in industry and DOD

Example: Exchanging a tail-component drawing for the F-15/F-14 between the Air Force and the Navy

MIL-M-28001

(SGML)

MIL-M-28001: Markup requirements for electronic output of text, a standard for generically tagging digital technical publications so that they can be transferred between computer systems in a consistent manner

Used to ensure that the content of technical documents is consistent from industry to DOD and within the Services

Example: Tagging a WARNING notice so that it is always recognized as such rather than random text.

MIL-D-28002 CCITT Gp 4

MIL-D-28002 is a standard which implements the CCITT Gp 4 international standard for use in exchanging raster graphics data between CAD/ CAM systems and engineering data repositories

Used to transfer engineering drawings between and among industry and DOD

Example: Transfer of an engine-part drawing between Pratt & Whitney and the Air Force

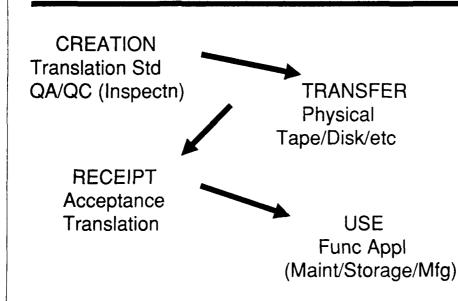
MIL-D-28003 CGM

MIL-D-28003 is the Computer Graphics Metafile (CGM) spec. which is an emerging industry standard for exchanging vector graphics between dissimilar systems

Used to exchange technical manual's graphic illustrations between and among industry and the Services

Example: Transfer a technical manual with illustrations from McDonnell-Douglas to the Air Force

CTN View DATA DELIVERY PROCESS



TYPES OF TESTING **CALS STANDARDS**

Category

Target

Development

Standard

Accomplished by Development Sites

Conformance

Products

Developed by NIST

Prototyped by CTN

Accomplished by Certified Labs

User/Application

Process

• Developed and Accomplished by CTN

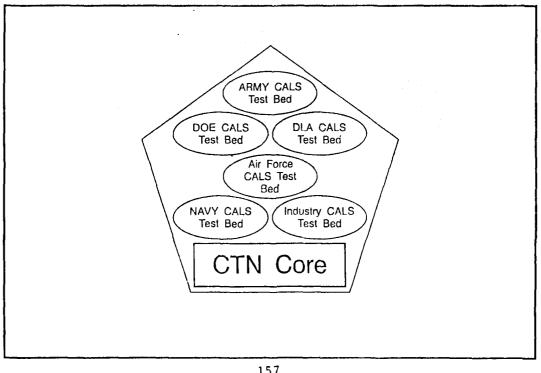
Acceptance

Data

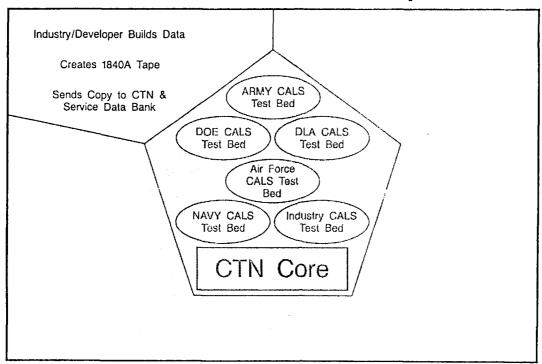
Developed by NIST and CTN

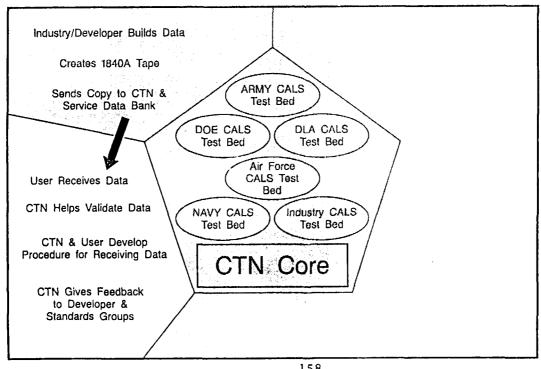
Prototyped by CTN

Accomplished by Receiving Sites

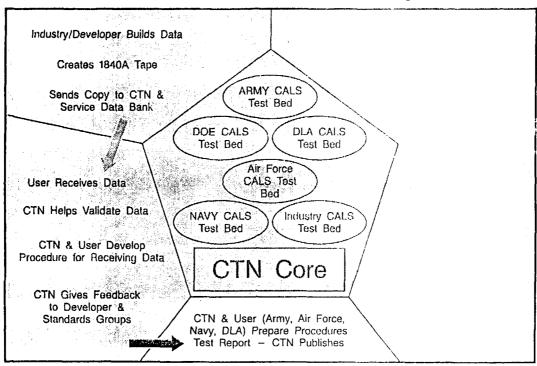


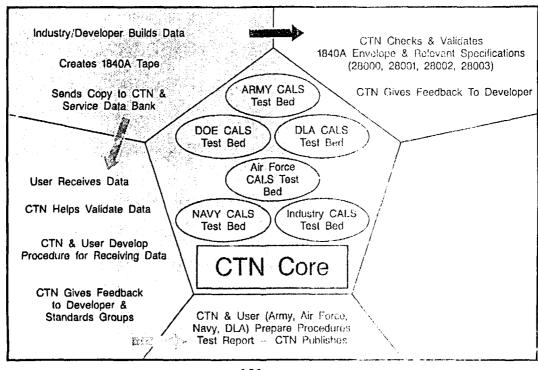
Functional Relationships



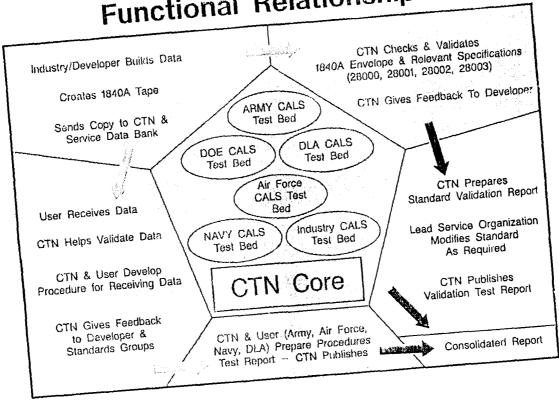


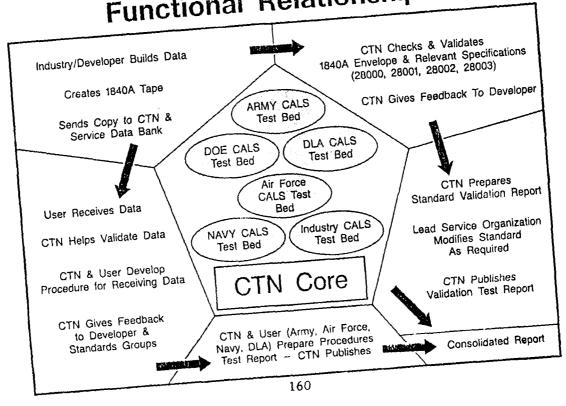
Functional Relationships





Functional Relationships





Lead Test Bed Concept I CALS Test Network

- Centers of Expertise for Applications Testing
 - Engineering Drawings
 - Technical Publications
 - Support Data
 - Data Protection & Security
 - Configuration Management

Lead Test Bed Concept II CALS Test Network

- Conduct Testing of Applications
 - Plan Tests
 - Conduct Tests
 - Analyze Results

Lead Test Bed Concept III CALS Test Network

- Focus for Service Testing
 - Test Plan Coordination
 - Test Results Archive
 - Test Results Publications (in CTN Format)

End-To-End Testing

What Is Involved

Creation

- Prepare Data (Skills)
- Structure According To MIL-STD-1840A
 - Tags, DTD's, OS for Text
 - CGM(28003), IGES(28000)
 Raster(28002) for Illus.
 - IGES(28000), Raster(28002)
 (PDES) for Drawings
 & Engineering Data
 - MIL-SPEC-1388-XX for LSA Data
 - X.12 for EDI Data

End-To-End Testing

What Is Involved

Creation

- Prepare Data (Skills)
- Structure According To MIL-STD-1840A
 - Tags, DTD's, OS for Text
 - CGM(28003), IGES(28000)
 Raster(28002) for Illus.
 - IGES(28000), Raster(28002)
 (PDES) for Drawings
 Engineering Data
 - MIL-SPEC-1388-XX for LSA Data
 - X.12 for EDI Data

Transfer

- Inspect Tape for Conformance with MIL-STD-1840A
 - Readable
- Header Data
- Individual Stds
- Involves Use of Computer Programs
- Expert Analysts Required
- Time Required

End-To-End Testing

What Is Involved

Creation

- Prepare Data (Skills)
- Structure According To MIL-STD-1840A
 - Tags, DTD's, OS for Text
 - CGM(28003), IGES(28000)
 Raster(28002) for Illus.
 - IGES(28000), Raster(28002)
 (PDES) for Drawings
 & Engineering Data
 - MIL-SPEC-1388-XX for LSA Data
 - X.12 for EDI Data

Transfer

- Inspect Tape for Conformance with MIL-STD-1840A
 - Readable
 - Header Data
 - Individual Stds
- Involves Use of Computer Programs
- Expert Analysts Required
- Time Required

Receipt

- Inspect Tape for Conformance with MIL-STD-1840A
- Readable
- Correct Data
- Usable Data
- Involves New Procedures& New Skills
- Greater Precision Possible
- Greater Accuracy will be Required

Prepare Final Report

End-To-End Testing

What Is Involved

Creation

- Prepare Data (Skills)
- Structure According To MIL-STD-1840A
 - Tags, DTD's, OS for Text
 - CGM(28003), IGES(28000)
 Raster(28002) for Illus.
 - IGES(28000), Raster(28002)
 (PDES) for Drawings
 & Engineering Data
 - MIL-SPEC-1388-XX for LSA Data
 - X.12 for EDI Data

Transfer

- Inspect Tape for Conformance with MIL-STD-1840A
- Readable
- Header Data
- Individual Stds
- Involves Use of Computer Programs
- Expert Analysts Required
- Time Required

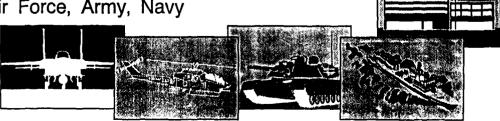
Receipt

- Inspect Tape for Conformance with MIL-STD-1840A
 - Readable
 - Correct Data
 - Usable Data
- Involves New Procedures& New Skills
- Greater Precision Possible
- Greater Accuracy will be Required

Prepare Final Report

Organization

- CALS Test Network Manager
- Includes Testing Participation by Army, Navy, DLA, Industry, Other Govt. Agencies
- Located in Hq Air Force Logistics Command
- Planned Joint Manning by Air Force, Army, Navy



CTN Review Board (CTNRB)

Actions and Membership

- *Review Test Proposals, & Recommend Priority to OSD
- *Review Test Results, Make Technical Recommendations
- *Report on CTN Progress & Distribute & Publish Test Results
- *Members: Chair, CTN Dir. OSD, Services, NIST, LLNL
- *Industry CALS Task Force Advisory Board

Schedule

- *First Meeting held 30 Mar 89 at NIST
- *Follow-up meeting on 16 May
- *Quarterly & as required for future meetings

Industry Participants

Applied Info Tech Research Cent AT&T Federal Systems Auto-Trol Technology Avalanche Development Boeing Military Airplane Cadkey Inc. CIMLINC Inc. Compugraphic Context Datalogics Inc DataServ Douglas Aircraft Co. General Dynamics Electric Boat General Dynamics Fort Worth General Electric Aircraft Engines Grumman Aerospace Corp Grumman Data Systems Honeywell Military Avionics Divison **Hughes Aircraft IBM** IGES Data Analysis Interleaf

IVF Sweden **Knowledeg Base International** Lockheed Georgia McDonnell Aircraft Co. Martin Marietta Elec & Missle Gp Northrop Corporation **Publishing Technologies** Pratt & Whitney Rockwell International Scribe Systems Inc. Softquad Inc. Software Exoterica STS Information Service Swedish Inst Prod Engr Research Sydeny Communications Ltd. Syscon Texas Instruments TRW Inc United States Video Corp Vitro Corporation Xerox Special Info Sys Xyvision Inc.

Government Agencies CALS Test Network

- Air Force Technical Order Mangement System (AFTOMS)
- Air Force EDCARS/Army DSREDS Engineering Data Repositories
- Air Force AFLC WR-ALC
- · Army CALS, Fort Monmouth, NJ
- Armament Mat. Readiness Cmd.
- · Lawrence Livermore National Laboratory (LLNL)
- · National Institute of Standards & Technology (NIST)
- Navy David Taylor Research Center (DTRC)
- Navy/DLA EDMICS Engineering Data Repositories
- · Navy Sea Combat Systems Engineering Station
- · DOE CALS Sandia Nat. Lab. & Oakridge Nat. Lab.
- · South Carolina Research Authority (SCRA)

Potential Participants CALS Test Network

- · Honeywell--Technical Manuals
- Boeing Military Airplane--Technical Manuals
- · Auto-Trol--IGES Sub-Set Testing
- Xerox Air Force 50S Program--CALS Compliance Testing
- Government Printing Office--Contractor(s) Testing
- Swedish & NATO--Document/Drawing Interchange

Actions and Dates CALS Testing

What is to be Tested	Who is Involved	Est. Completion
Technical Publication Segment 1-SGML & 1st Set of DTDs & Illust.	Industry, CTN, Software Makers,Govt	1st Qtr FY 90
Technical Publication Segment 2-Output Spec & 2nd Set of DTDs & Illustrations	Industry, CTN, Software Makers,Govt	1st Qtr FY 91
Engineering Drawing Segment 1-IGES I,II	Industry, CTN, Software Makers,Govt	2nd Qtr FY 90
Engineering Drawing Segment 2-IGES III,IV	Industry, CTN Software Makers,Govt	2nd Qtr FY 91

Actions and Dates CALS Testing

What is to be Tested	Who is Involved	Est. Completion
Engineering Drawing Segment 3-RASTER, No tiling	industry, CTN, Software Makers,Govt	2rd Qtr FY 90
Engineering Drawing Segment 4-RASTER, Tiling	Industry, CTN, Software Makers,Govt	2nd Qtr FY 91
LSA/LSAR, SQL	Industry, CTN, Software Makers,Govt	4th Qtr FY 91
LSA/LSAR, Relational Data Base	Industry, CTN Software Makers,Govt	2nd Qtr FY 92

CTN

Benefits

- Quality Improvements to Digital Data Delivery Process
 - Demonstration/Enrichment of CALS Standards
- Users' Needs Addressed
 - Weapon Systems Contractors
 - DOD/Other Government Agencies
 - Vendors Who Provide Products and Services
- Widely Tested Standards and Methods
 - -- Accelerated Confidence in Use of CALS Standards
 - Implementation of Direction in Taft Memo



CALS PHASE I.2 "IGES VALIDATION"

DAVID O. REMINGTON NSWC SILVER SPRING, MD



CALS PHASE I.2 - "IGES VALIDATION"

CAN'T BE DONE! CAN'T

CAN'T BE DONE!

CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T BE DONE! CAN'T

...SO, FOR IGES, WHAT:

- CAN BE DONE?
- IS BEING DONE?



CALS PHASE I.2 - "IGES VALIDATION"

WHAT IS IGES?

- A PHYSICAL FILE FORMAT
- A SET OF RULES FOR MAPPING VARIOUS ENTITIES AND THEIR ATTRIBUTES TO THAT FORMAT

BUT...

AT PRESENT, NO OTHER CONFORMANCE REQUIREMENTS TO BE ABLE TO SAY:

"MY TRANSLATOR SUPPORTS IGES!"



CALS PHASE I.2 - "IGES VALIDATION"

NO NEED TO:

- SUPPORT A MINIMUM NUMBER OF ENTITIES
- MAP A "LINE" TO A "LINE"
- GRACEFULLY HANDLE UNSUPPORTED ENTITIES...

ETC.

IN SPITE OF ALL THIS:

A PRACTICAL, USEFUL TESTING PROGRAM IS UNDER WAY!



CALS PHASE I.2 - "IGES VALIDATION"

THE IGES TESTING PROJECT

- VERIFICATION
- APPLICATION VALIDATION
- USER ACCEPTANCE
 ALL WITH TEST CASE SUPPORT

CALS TESTING TERMS: (IGES)

- DEVELOPMENTAL
- CONFORMANCE APPLICATION VALIDATION
- APPLICATION/USER
 APPLICATION VALIDATION
 USER ACCEPTANCE
- ACCEPTANCE

WHERE DOES VERIFICATION FIT?



CALS PHASE 1.2 - "IGES VALIDATION"

YET ANOTHER SET OF TERMS:

- ACCEPTANCE TESTING
- CONFORMANCE TESTING
- FITNESS TESTING
- PERFORMANCE TESTING
- ROBUSTNESS TESTING

VERIFICATION TESTING:

- BASED ON VENDOR MAPPING CLAIMS
- CONDUCTED BY INDEPENDENT, THIRD PARTY
- SINGLE TRANSLATOR
- DRAFT METHODOLOGY IN PLACE
- TEST OF <u>METHODOLOGY</u> UNDER WAY
- TEST CASE INTENSIVE
- NO PASS-FAIL OR GOOD-BAD



CALS PHASE I.2 - "IGES VALIDATION"

APPLICATION VALIDATION TESTING:

- BASED ON AN INFORMATION MODEL
- INTRODUCES THE CONCEPT OF AN APPLICATION PROTOCOL RATHER THAN A SUBSET
- PARALLELS MIL-D-28000 IN CONTENT
- CAN BE BASIS FOR CONFORMANCE TESTING
- DESCRIBED IN NISTIR 88-3846
- NO APPLICATION PROTOCOLS YET COMPLETE
- CAN BE APPLIED BY IMPLEMENTOR OR USER
- EXTENDS BEYOND IGES TO PDES/STEP

ACCEPTANCE TESTING:

- END-TO-END DATA EXCHANGE
- USER ENVIRONMENT DRIVEN
- METHODOLOGY AND TEST CASE DEVELOPMENT STRATEGY IN USABLE, DRAFT FORM
- "SUCCESSFUL" TESTING WILL NOT GUARANTEE "APPLIANCE TECHNOLOGY"
- AVAILABLE THROUGH IGES/PDES ORGANIZATION USER INFORMATION COMMITTEE



CALS PHASE I.2 - "IGES VALIDATION"

WHERE ARE WE?

- NOTHING TODAY
- A FORMAL VERIFICATION PROGRAM START DATE_____
- A METHODOLOGY FITTING CALS REQUIREMENTS MORE CLOSELY AND EXTENSIBLE TO NEWER STANDARDS THAN IGES IS MOVING TOWARD A USABLE STATE
- SOME HELP FOR THE END USER

WHAT'S TO BE DONE?

- UNTIL BETTER COMES ALONG, THE VERIFICATION PROGRAM TESTED, MODIFIED, AND IMPLEMENTED
- CONFORMANCE REQUIREMENTS ADDED TO IGES (VERSION 5.0)
- APPLICATION PROTOCOLS TO MATCH MIL-D-28000 VALIDATED
- CALS COMMUNITY MADE AWARE OF IGES/PDES TESTING PROGRESS

1989 CALS STANDARDS



PHASE 1.2

Mr. Bruce Lepisto

1989 CALS STANDARDS

OVERVIEW

DEVELOPMENT OF STANDARDS

- ELECTRONIC DATA INTERCHANGE
- COMPUTER AIDED DESIGN DATA
- LOGISTIC SUPPORT ANALYSIS DATA
- TECHNICAL MANUAL PUBLISHING, ELECTRONIC DISTRIBUTION

DEFINITION OF FUNCTIONAL REQUIREMENTS

- CONTRACTOR INTEGRATED TECHNICAL INFORMATION SERVICE
- RISK ASSESSMENT OR SYSTEM / DATA PROTECTION AND SECURITY

TESTING OF STANDARDS

- STANDARDS DEVELOPMENT TESTING
- PRODUCT CONFORMANCE TESTING
- USER APPLICATION TESTING
- DATA ACCEPTANCE TESTING

CURRENT CALS STANDARDS

DoD STANDARD	DATE	NAT'L/INT'L STANDARD	APPLICATIONS
MIL-STD-1840A	DEC 87	-	DATA INTERCHANGE/FILE MANAGEMENT
MIL-D-28000	DEC 87	IGES	CAD, VECTOR GRAPHICS - ENG DRAWINGS - TM ILLUSTRATIONS - NC MACHINING
MIL-M-28001	FEB 88	SGML	AUTOMATED PUBLISHING - TECHNICAL MANUALS
MIL-R-28002	DEC 88	CCITT 4	RASTER SCANNED IMAGES - ENG DRAWINGS - TM ILLUSTRATIONS
MIL-D-28003	DEC 88	CGM	VECTOR GRAPHICS - TM ILLUSTRATIONS
MIL-HDBK-59	DEC 88	-	IMPLEMENTATION GUIDE - MODEL SOWS, CDRLS

1989 CALS STANDARDS

ELECTRONIC DATA INTERCHANGE

DOD COMMITMENT TO A DIGITAL COMMERCIAL ENVIRONMENT

- CALS -- TECHNICAL DATA
- EDI -- BUSINESS DATA

INTEGRATION OF CALS AND EDI

- EDI TRANSACTION SETS TO ORDER AND ACCESS TECHNICAL DATA
- EDI ENVELOPES TO TRANSMIT TECHNICAL DATA PACKAGES ACROSS INDUSTRIAL NETWORKS

MIL-STD-1840A AND ANSI X12

- PROPOSED TRANSACTION SET 839 "TECHNICAL INFORMATION, NON-PARAMETRIC"
- TECHNICAL SPECIFICATION DRAFT JULY 1989

1989 CALS STANDARDS

COMPUTER AIDED DESIGN DATA

STANDARDS FOR ELECTRONICS PRODUCTS - INTEGRATED CIRCUITS, PRINTED CIRCUIT BOARDS, ETC.

- APPLICATION DOMAINS FOR EDIF, IGES, IPC, VHDL
- EIA COMMITTEE RECOMMENDATIONS
- DEFINE REQUIREMENTS IN MIL-STD-1840A AND MIL-HDBK-59 MAY 1989
- FUTURE MILITARY SPECIFICATIONS TO IMPLEMENT EVOLVING INDUSTRY PROTOCOLS

MIL-D-28000, AMENDMENT 2

- CLASS 5 SUBSET 3-D PIPING AND TUBING
- APPLICATION PROTOCOL DEVELOPMENT
- SSN-21 SEAWOLF, NIDDESC, IGES AEC
- DRAFT AMENDMENT 2 SEPTEMBER 1989

1989 CALS STANDARDS

LOGISTIC SUPPORT ANALYSIS DATA

MIL-STD-1388-2B, LSA RECORD REQUIREMENTS

 FROM FLAT FILE BATCH PROCESSING TO RELATIONAL DATA BASE MANAGEMENT CAPABILITY

DEVELOPMENT PROCESS

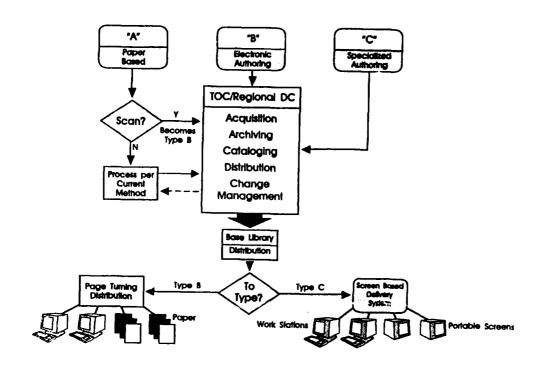
- FORMAL IDEF1x DATA MODELING
- TABLE DEFINITION FOR MIL-STD-1388-2B
- SQL IMPLEMENTATION TOOLS

DEVELOPMENT SCHEDULE

- MIL-STD-1388-2B MAY 1989 DRAFT, DECEMBER 1989 PUBLICATION
- IDEF1x MODEL AND SQL JUNE 1989 TECHNICAL REPORT, SEPTEMBER 1989 DRAFT SPECIFICATION
- GOVERNMENT DBMS SOFTWARE JANUARY 1990

1989 CALS STANDARDS

TECHNICAL MANUALS



1989 CALS STANDARDS

PAGE-ORIENTED TECHNICAL MANUALS

CURRENT PROGRAM REQUIREMENTS

- EXISTING TMSS SPECIFICATIONS AND STANDARDS
- SERVICE-DEVELOPED DTD's, OS's IAW MIL-M-28001
- DTD REGISTRATION THROUGH TMSS PROGRAM

FUTURE PROGRAM REQUIREMENTS

- JOINT-SERVICE TMSS SPEC CONSOLIDATION
 - -- MIL-STD-361, MIL-M-63008
- CALS-DEVELOPED FAMILY OF JOINT-SERVICE DTD's, OS's TO BE INCORPÓRATED IN MIL-M-28001
 - -- 15-20 DTD's DEVELOPED OVER 2-3 YEARS
 - -- SERVICE-ESTABLISHED PRIORITIES
 - BUILD FROM WORK UNDERTAKEN TO MEET CURRENT PROGRAM REQUIREMENTS (eg, AFTOMS)

1989 CALS STANDARDS MIL-M-28001 FOR AUTOMATED PUBLISHING

MIL-M-28001A

- REORGANIZED TO SIMPLIFY FUTURE EXTENSIONS
- DTD REVISION BASED ON TESTING, VENDOR IMPLEMENTATION
- DECLARATION SUBSETS FOR APPLICATION TO OTHER TMSS SPECIFICATIONS
- OUTPUT SPECIFICATION TEMPLATE, APPLICATION INSTANCE (FOSI) FOR MIL-M-38784 MANUALS
- JULY 1989 DRAFT, DECEMBER 1989 PUBLICATION

MIL-M-28001A, AMENDMENT 1

- EXTEND APPLICATION BASED ON AFTOMS DTD DEVELOPMENT
- COMPATIBLE WITH MIL-STD-361 OBJECTIVES
- 1990 PUBLICATION

1989 CALS STANDARDS

PAGELESS TECHNICAL MANUALS

INDUSTRY-DOD PTM COMMITTEE

- CONCEPTS AND REQUIREMENTS FOR AUTHORING SYSTEMS, DATA INTERCHANGE, DELIVERY SYSTEMS
- TECHNICAL ADVISORY GROUP FOR DoD FOLLOW-ON SPECIFICATION DEVELOPMENT

JOINT-SERVICE REQUIREMENTS FOR A-12, ATF

- DRAFT SPECIFICATIONS MARCH 1990
- INTEGRATED FAMILY OF SPECIFICATIONS
 - -- CONTENT, STYLE, FORMAT REQUIREMENTS
 - -- REVISABLE SOURCE DATA
 - -- EXTRACTION AND DISPLAY FORMATTING
 - -- PRESENTATION SYSTEMS
 - -- QUALITY ASSURANCE
- A-12, ATF PROTOTYPES, DoD-WIDE APPLICATION

1989 CALS STANDARDS

OTHER GUIDANCE

MIL-R-28002, CHANGE NOTICE 1

- CLARIFICATION ON GROUP 4 RASTER BIT / BYTE ENCODING SEQUENCE
- JUNE 1989 PUBLICATION

MIL-HDBK-59, AMENDMENT 1

- EXECUTIVE SUMMARY FOR PROGRAM MANAGERS
- STANDARDS FOR ELECTRONICS PRODUCTS
- LCGISTIC SUPPORT ANALYSIS DATA
- CITIS, PAGELESS TECHNICAL MANUALS, EDI
- DATA PROTECTION, COMMUNICATIONS
- SEPTEMBER 1989 DRAFT, MAY 1990 PUBLICATION

1989 CALS STANDARDS

SUMMARY OF 1989 INCREMENT

- MIL-HDBK-59
 - -- PROGRAM MANAGER'S EXECUTIVE SUMMARY
 - -- EXTENSIONS FOR 1989 STANDARDS
- MIL-STD-1840A
 - -- ELECTRONIC DATA INTERCHANGE
 - -- EDIF, IPC, VHDL REQUIREMENTS
- MIL-D-28000
 - -- CLASS V SUBSET, PIPING & TUBING
- MIL-M-28001
 - -- EXPANDED APPLICATION, OUTPUT SPEC
- MIL-R-28002
 - -- TECHNICAL CLARIFICATION
- MIL-STD-1388-2A
- -- REVISION FOR RELATIONAL DBMS TABLES PLUS
- DEVELOPMENT WORK FOR 1990 INCREMENT

1989 CALS STANDARDS

STANDARDS REVIEW PROCESS

INCREMENTAL RELEASES THROUGHOUT 1989

BASIC TIMETABLE

RELEASE DRAFT FOR COMMENTS

BEGIN REVIEW AND CONSOLIDATION - 3 MONTHS

RECONCILIATION DRAFT FOR COORD - 6 MONTHS

PUBLISH - 8 MONTHS

1989 CALS STANDARDS

CITIS FUNCTIONAL REQUIREMENTS

DEFINE FUNCTIONAL REQUIREMENTS FOR CONTRACTOR INTEGRATED TECHNICAL INFORMATION SERVICES

- ESTABLISH BASELINE CURRENT, ANTICIPATED CONTRACTOR CAPABILITIES
- DOCUMENT DoD REQUIREMENTS
- DEFINE IMPLEMENTATION STRATEGY

CALS ISG TECHNICAL ADVISORY GROUP

- ASSIST IN DEFINING ISSUES AND PRIORITIES
- VALIDATE ASSUMPTIONS, REVIEW TASK PRODUCTS

DRAFT FUNCTIONAL REQ'TS SPECIFICATION (JUNE 1990)

- MINIMUM INTEGRATION REQUIREMENTS
- DATA ACCESS, ACCEPTANCE PROCEDURES
- DISPLACEMENT OF DATA DELIVERABLES
- FUNCTIONAL CAPABILITIES
- APPLICATION DURING FSD, PRODUCTION PHASES

1989 CALS STANDARDS

GENERIC RISK ASSESSMENT

GENERIC ASSESSMENT OF SYSTEM / DATA RISK IN A CALS DIGITAL ENVIRONMENT

- REFERENCE MODEL FOR USE IN PREPARING SITUATION-SPECIFIC RISK ASSESSMENTS
- NEAR-TERM FILE INTERCHANGE, LONGER-TERM INDUSTRIAL NETWORKS
- CLASSIFIED AND SENSITIVE UNCLASSIFIED DATA
- THREATS AND VULNERABILITIES
- POTENTIAL COUNTERMEASURES

CALS ISG TECHNICAL ADVISORY GROUP

ISSUES, PRIORITIES, ASSUMPTIONS, REVIEW

GENERIC RISK ASSESSMENT (JUNE 1990)

 INCLUDING PROPOSED AGENDA FOR TECHNOLOGY DEVELOPMENT, DEMONSTRATION, STANDARDIZATION

1989 CALS STANDARDS TESTING RESPONSIBILITIES

STANDARDS DEVELOPMENT TESTING

 ACCOMPLISHED BY DEVELOPMENT SITES, SUPPORT ACTIVITIES - eg, NATIONAL PDES TESTBED

PRODUCT CONFORMANCE TESTING

- DEVELOPED BY NIST, PROTOTYPED BY CTN
- IMPLEMENTED BY GOV'T, INDUSTRY TESTING LABS

USER APPLICATION TESTING

- CONDUCTED BY CALS TEST NETWORK
- FOCUS ON TARGET CAPABILITIES, SUCH AS DIGITAL DELIVERY TO Dod REPOSITORIES

DATA ACCEPTANCE TESTING

- DEVELOPED BY DoD AND NIST, PROTOTYPED BY CTN
- PROCESS QUALIFICATION TO MINIMIZE THE REQUIREMENT FOR DATA INSPECTION

1989 CALS STANDARDS

CALS TESTING PROGRAM AT NIST

IGES TESTING (MIL-D-28000)

- TEST CASE DEVELOPMENT AND SOFTWARE TOOLS
- INITIAL TESTS ON MAJOR CAD SYSTEMS
- SUPPORT FOR SAE NATIONAL TESTING PROGRAM

SGML TESTING (MIL-M-28001)

- CONFORMANCE TEST STRATEGY (Incl OS's)
- NIST REFERENCE PARSER

RASTER TESTING (MIL-R-28002)

 REQUIREMENTS, PROCEDURES TO ADAPT NCS TESTING PROGRAM TO MIL-R-28002 REQ'TS

CGM TESTING (MIL-D-28003)

- CONFORMANCE TEST REQUIREMENTS
- EXPEDITE VALIDATION ROUTINE DEVELOPMENT

1989 CALS STANDARDS

CALS TESTING PROGRAM AT NIST

PDES NATIONAL TESTBED

- SUPPORT FOR THE IGES-PDES ORGANIZATION
- SUPPORT FOR PDES, INC.

REQUIREMENTS, STRATEGY FOR IRDS TESTING

OTHER TESTING ACTIVITIES AT NIST

- PROPOSED FEDERAL INFORMATION PROCESSING STANDARD ON CONFORMANCE TESTING
- CERTIFICATION REQUIREMENTS FOR TESTING LABORATORIES

1989 CALS STANDARDS

CALS TEST NETWORK (CTN)

AIR FORCE LEAD SERVICE ACTIVITY

- COORDINATE GOVERNMENT-INDUSTRY TESTBEDS
 - -- LEAD TESTBED CENTERS OF EXPERTISE
 - -- GOVERNMENT CTN REVIEW BOARD
 - -- INDUSTRY CTN ADVISORY BOARD
- CONDUCT USER APPLICATION TESTING
- PROTOTYPE CONFORMANCE, DATA ACCEPTANCE TESTS

TARGET CAPABILITY PRIORITIES

- DELIVERY OF MIL-R-28002 ENGINEERING DATA TO Dod REPOSITORIES
- DELIVERY OF MIL-M-28001 TECHNICAL MANUAL TEXT AND GRAPHICS
- DELIVERY OF MIL-D-28000 CAD DATA
- ASSESSMENT OF NEEDS SECURITY, INTEGRATED WEAPON SYSTEM DATA, EXCHANGE METHODOLOGY

1989 CALS STANDARDS

SUMMARY

STANDARDS IN PROCESS TO PROVIDE

- EXTENDED TECHNICAL CAPABILITY
- INCREASED FUNCTIONALITY
- BROADER APPLICATION

FUNCTIONAL REQUIREMENTS BEING DEFINED FOR

- INTEGRATION OF TECHNICAL INFORMATION CAPABILITIES
- RISK ASSESSMENT IN CALS ENVIRONMENT

TESTING CAPABILITY EVOLVING TO

- STRENGTHEN STANDARDS
- SUPPORT PRODUCT IMPLEMENTATION
- FACILITATE ROUTINE USE

CALS PHASE I.2 CONFERENCE REGISTRANTS LIST 2 MAY 1989

Mr. Thomas R. Abel Logistics Systems Architects 3800 Watt Avenue Sacramento, CA 95821 916-348-2200

Mr. Bill D. Adams I-Net, Inc. 11426 Rockville Pike Suite 108 Rockville, MD 20852 301-230-1320

Mr. Charles Adams XMCO, Inc 11150 Sunrise Valley Reston, VA 22091 703-648-9679

Ms. Margaret Adams Avalon Communications 3420 Kashiwa Street Torrance, CA 90717

Mr. V Adams Boeing P.O. Box 33126 Philadelphia, PA 08013

Mr. Joseph Albergo HQ/USAF/LE-YM The Pentagon Washington, DC 20330-5130

Mr. Boli Alfaro Tandem Computers 12100 Sunrise Valley Reston, VA 22091 703-470-3225 Mr. Steve Alhbrand Johns Hopkins App Phy Lab Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Mr. Scott M. Allard Mgmt. Consulting & Res. 5113 Leesburg Pike Suite 509 Falls Church, VA 22041 703-820-4600

Mr. Guy Z. Allen Supply Tech, Inc. 27784 Franklin Rd. Southfield, MI 48034 313-357-3430

Mr. Robert F. Allen Mission Engineering Corp. 1225 Jefferson Davis Hwy. Suite 415 Arlington, VA 22202 703-892-0600

Mr. Lawrence E. Allers Raytheon Service Co. 2 Wayside Rd. Burlington, MA 01803 617-272-9300

Mr. L.E. Alper Allied-Signal Aerospace Flight Systems Div. Teterboro, NJ 07608

Mr. Robert S. Andersen Allied-Signal Aerospace Rt Y6 Teterboro 17/8 Hasbrouck Heights, NJ 07608 201-487-9955 Mr. William Anderson Naval Sea Logistics Cntr PO Box 2060 Mechanicsburg, PA 17055 717-790-2958

Mr. Yuri B. Andrijuk Automated Systems 6591 IS 8900 E. Washington Pico Rivera, CA 90660 213-948-6836

Mr. Frank G. Ankner Fairchild Industries 20301 Century Blvd. MS B-24 Germantown, MD 20874 301-641-2272

Mr. Wayne B. Archer AFHRL/MOD Brooks AFB San Antonio, TX 78235 512-536-3551

Mr. Joseph Arcieri Defense Logistics Agency (WSIAO) Cameron Station Alexandria, VA 22304-6183

Mr. Bruce Armstrong Code 3711 Navy Gage & Standards Center Naval Weapons Sta., Seal Beach P.O. Box 2426, Pomona Annex Pomona, CA 91769 714-620-0533

Mr. John A. Armstrong USAF Space Sys Div SSD ALXN P.O. Box 92960 Los Angeles, CA 91351 213-643-1278 Lt. Herbert L. Atkins EG&G 2143 Jefferson Davis Hwy Arlington, VA 22202 703-553-2147

Mr. Thomas M. Atwood Object Design, Inc. 1 N England Exec Pk Burlington, MA 01803 617-270-9797

Mr. Frank J. Austin Booz-Allen & Hamilton 17305 Dowdon Way Foolesville, MD 20837 301-769-7690

Mr. John Larry Baer Int'l Mgt & Eng Consult. 4206 Elizabeth Lane Annandale, VA 22003 703-323-6952

Mr. James I. Baginski Amtec Sys Corp. RD1 Box 217 Branchville, NJ 07826 201-875-1225

Mr. Bill T. Bailey General Dynamics P.O. Box 748 Mail Code 5995 Ft. Worth, TX 76101 817-777-0974

Mr. Seenu Banda Integrated Solutions 1140 Ringwood Court San Jose, CA 95131 408-943-0626

Mr. Anthony Baranyi Litton Systems Canada 25 Cityview Dr. Etobitoke, Ontario, CN M9W5A 416-246-2101 Mr. Richard Barclay Intergraph Corp. 17731 Mitchell Road Irvine, CA 92714 717-869-9170

Mr. Donald E. Bargabus Ardon Industries 24542 Vanessa Dr. Suite 200 Mission Viejo, CA 92691 714-951-9014

Mr. Purl Barnard USAF 00-ALC/SCCC Hill AFB, UT 84056

Mr. Ed L. Barnes CACI 1725 Jefferson Davis Hwy Suite 1003 Arlington, VA 22202 703-553-4983

Ms. Jean M. Baronas NIST B263/Tech Gaithersburg, MD 20899 301-975-3338

Mr. Tony Barrett AT&T Technologies 85 & MT Hope Church Rd Greensboro, NC 27420

Mr. George Barthelenghi GAI 21 White Deer Plaza Spartz, NJ 02871

Mr. Jack Bartley OASD(A&L)/SS The Pentagon, Rm 1B466 Washington, DC 20301 202/637-5216 Mr. James A. Bateman US Navy Rm 348 Washington, DC 20360 202-692-1106

Mr. Philip E. Battey Navy Rm 100, Bldg 17 Carderock, MD 20084 202-227-1461

Mr. John Baudier TAMSCO 4041 Powder Mill Rd. Suite 500 Calverton, MD 20705 301-937-1799

Ms. Kathryn Beatty UNISYS PO Box 64525 St. Paul, MN 55164

Mr. Victor Beaumont Tracor Applied Sciences 2231 Crystal Drive Suite 600 Arlington, VA 22202 703-553-1553

Mr. William G. Beazley W.G. Beazley and Assoc. 13939 NW Freeway Suite 270 Houston, TX 77040 713-690-7644

Mr. Brian J. Beck Astra Holdings Corp. 8260 Greensboro Dr. Suite 330 McLean, VA 22102 203-790-1155

Mr. Brad K. Becker Boeing 555 N Woodlawn PO Box 7730 Wichita, KS 67277 316-689-1116 Mr. Robert W. Beckett US Gov't Printing Office N Capitol & H St, NW Washington, DC 20401 202-275-2621

Ms. Rosie Beckham EG&G WASCI 2341 Jefferson Davis Hwy Suite 800 Arlington, VA 22202 703-553-3460

Mr. Patt Beedout Lockheed Aeronautical Dept 83-14 B67 PLT A-1 Burbank, CA 91520

Mr. Gary Been Infostram Systems 8019 Via Pompeii Burbank, CA 91504

Ms. Gretchen Beers Dept Energy Idaho Nat'l Engr. 1955 Freemont Avenue Idaho Falls, ID 83415

Mr. Matthew Belovarich Bendix Field Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. William Belvin PAIV, Inc 5 Proctor Hill Rd. Hollis, NH 03049 603-465-2337

Mr. Bart E. Bennett The Rand Corporation 1700 Main Street Santa Monica, CA 90406 Mr. Cliff Bennett JHU/APL Johns Hopkins Rd. 14-816 Laurel, MD 20707 301-792-5000

Mr. Harry Benoit Automated Sciences Group 700 Roeder Rd. Silver Spring, MD 20910 301-587-8750

Capt. Douglas R. Bensing USAF HQ BMO/SDHP Norton AFB, CA 92409 714-382-3092

Mr. Larry J. Benson AMCCOM AMSMC-LSP Rock Island, IL 61299 309-782-5852

Mr. Philip A. Benyola E-Systems, ECI Div 1501 72nd St., N PO Box 12248 St. Petersburg, FL 33733 813-381-2000

Mr. Carl L. Berry Defense Quality & Stand 5203 Leesburg Pike Suite 1403 Falls Church, VA 22041 703-756-2554

Mr. David Berryhill FAA 6500 S. MacArthur Blvd Oklohoma City, OK 73125

Mr. William Betts Natra Datavision 400 Corporate Pt Suite 555 Culver City, CA 90230 213-410-1400 Mr. David S. Bettwy NIST Bldg. 233/B106 Gaithersburg, MD 20899

Mr. Paul E. Beyer Boeing Military Airplanes K76/51 3801 S. Oliver Wichita, KS 67277

Mr. James E. Bickel GE Government Services 5200 Valentine Rd. Ventura, CA 93003 805-983-2067

Mr. Richard Biedenbender ERC 1725 Jefferson Davis Hwy. Crystal Sq. 2, Suite 200 Arlington, VA 22202 703-979-8220

Mr. William R. Bien IBM 9500 Godwin Dr. 876/EZK Manassas, VA 22110 703-367-2053

Mr. Timothy E. Billington Aquidneck Data Corp 170 Enterprise Cntr. Middletown, RI 02840 401-847-7260

Mr. James S. Black Honeywell, Inc 9201 San Mateo Blvd. Albuquerque, NM 87113 505-828-7703

Mr. Daniel J. Blanchard Sikorsky Aircraft 6900 Main St. B102A Stratford, CT 06601 203-384-7050 Ms. Suzanne Blanchett NSC T-2134 Ft. George G. Meade, MD 20755 301-859-6004

Mr. Robert Bloom G P Taurio 1901 N Beauregard Suite 300 Alexandria, VA 22311 703-845-4465

Mr. Brad Blough Menton Graphics Corp 15204 Omega Dr. Suite 110 Rockville, MD 20850 301-990-1265

Mr. Alex Bocast Department of Defense

Ms. Barbara A. Bochenski Boeing Computer Services PO Box 33126 P30-58 Philadelphia, PA 19142 215-591-4447

Mr. Bruce Bodnyk AMP Incorporated P.O. Box 3608 MS 140-61 Harrisburg, PA 17105

Mr. Dee R. Bogard Hughes Aircraft Co 627 M410 Box 3310 Fullerton, CA 92634 714-970-4194

Mr. James Bolton Central Federal Systems 11400 Commerce Park Drive Reston, VA 22091 703-758-7000 Mr. Daniel Bonneau Oerlikon 225 Seminaire Blvd S St. Jean, Quebec, CN J3B8E 514-358-2000

Mr. Howard Boone Automation Res Systems 4480 King St. Suite 500 Alexandria, VA 22302 703-820-9000

Ms. Carol F. Booth ManTech 2320 Mill Rd. Alexandria, VA 22314 703-838-5600

Mr. Fred B. Bornemann IBM 1301 Piccard Dr. 211 Rockville, MD 20850 301-640-5981

Mr. John Boucher Analysis & Technology R58 Bank Street New London, CT 06379

Mr. John F. Bourgein Image Management Assoc. 6363 Christie Avenue Suite 2127 Energyville, CA 94608 415-658-4174

Mr. Jeff Bowman Ballistic Missile Norton AFB, CA 92409 714-382-7821

Mr. Stacie Bowman IBM Corp. 455 W. Maude Ave. Sunnyvale, CA 94086 408-720-4514 Mr. Gary Boycan DOD Pentagon Rm 3B930 Washington, DC 22031 202-695-6940

Ms. Barbara Boyd Digital Equipment 8300 Professional Pl Suite 119 Landover, MD 20785 301-731-6509

Mr. Larry Boyd Convergent Solutions 2091 Business Ctr Dr. Suite 100 Irvine, CA 92715 714-851-3004

Mr. Hartford Boykin D. Appleton Company 1334 Park View Avenue Suite 220 Manhattan Beach, CA 90266 213-546-7575

Mr. Jerry Brady Texas Instruments P.O. Box 869305 MS-8420 Plano, TX 75086

Mr. Philip C. Bragg Teledyne Brown Eng. 300 Sparkman Dr. PO Box 070007, MS180 Huntsville, AL 35807 205-726-1958

Mr. Jack Brainin Navy/DTRC Bethesda, MD 20084

Mr. James Brazelton Headquarters AFLC/MMDB Wright Patterson AFB, OH 45433 513-257-2229 Mr. Ray Brengs U.S. Navy OP 46 Pentagon, Rm 40540 Washington, DC 20350 Mr. Cliff Brown Goddard Space Flight Ctr. Greenbelt, MD 20071 301-286-5700 Mr. Blaine R. Brucker US Navy NAVSEA Washington, DC 202-692-1888

Mr. Doug Brenner AT&T Holmdel, NJ 201-949-0755 Mr. George Brown GWB Associates 21 Holden Road Belmont, MA 02178 Mr. Frederick Buchman General Dynamics-Vly Sys Div P.O. Box 50-800 Ontario, CA 91761 714-945-6103

Mr. Harry Brewer Rockwell International Corp. Dept. 432/011, ZM02 100 N. Sepulveda Blvd. El Segundo, CA 90245 213-414-4255 Mr. Ken Brown Landar Int'l Defense Svc. Brickworth Ln. Salisbury Wilts, England 079-488-4239 Mr. Don Buckley Harris Corp. P.O. Box 37 M.S. 15/8741 Melbourne, FL 32902 407-729-2211

Ms. Mary E. Brickerd Harry Diamond Labs 2800 Powder Mill Rd. SCHLO Adelphi, MD 20873 301-394-2600 Mr. Robert Brown Martin Marietta 103 Chesapeake Park Plaza MS/E465 Baltimore, MD 21220 301-682-1556

Mr. Henry J. Bukowski EER Systems 20251 Century Blvd. Germantown, MD 20874 301-428-0414

Mr. F. Brinton Army Materiel Command 5001 Eisenhower Ave. Alexandria, VA 22333 202-274-8949 Mr. Thomas Brown 514 Spencer Lane Warminster, PA 18974 Mr. George L. Bullion Computer Sci Corp 1 N Revmont Dr. Suite 30 Shrewsbury, NJ 07701 201-389-3410

Mr. Kay Briula AMP Inc. P.O. Box 3608 MS 109-002 Harrisburg, PA 17105 Mr. Thomas L. Brown Wheeler Industries, Inc. 2611 Jefferson Davis Hwy Suite 1200 Arlington, VA 22202 703-418-1500 Mr. Juan B. Bulnes Xerox Corp. 475 Oakmead Parkway Sunnyvale, CA 94086 408-737-4643

Mr. Robert W. Brock Honeywell Federal Systems 7900 Westpark Dr. MS 1111B McLean, VA 22102 703-827-3651 Mr. Tom Brown NESEC SD P.O. Box 336-5431 Poway, CA 92064 619-748-2675 Mr. Michael Burnham UNISYS 55 Broadway Cambridge, MA 02142 617-494-2688

Ms. Susan B. Brookins NAVAIR AIR-41144A Washington, DC 20361 202-746-0842 Mr. William C. Brown Goddard Space Flight Ctr. NASA-GSFC Code 534.4 Greenbelt, MD 20771 301-286-7581 Mr. Lance Burns U.S. Army PM CALS AS-PES-CA Ft. Monmouth, NJ 07703-5000 Mr. Pete Butziger Computer Science Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Mr. Robert J. Byron General Dynamics 5001 Kearny Villa Rd C6 1980 San Diego, CA 92128 619-694-7129

Mr. J. Scott Calhoun Inst for Tech Development 1 Research Blvd. Suite 105 Starkville, MS 39759 601-325-2240

Mr. Robert Calogero Director, SEA CEL-PA Naval Sea Systems Command Washington, DC 20362 202-692-1360

Mr. Alfred Campo OAS Army (I&L) The Pentagon Room 3E620 Washington, DC 20310

Mr. Aaron L. Carier Hughes Aircraft Co P.O. Box 9399 C512016 Long Beach, CA 90810 213-513-5861

Mr. William Carpenter Sundstrand 4747 Harrison Avenue Suite 7002 Rockford, IL 61125

Mr. Clive C. Carpi STS Info Sys 1101 King St. Suite 601 Alexandria, VA 22314 703-838-9202 Ms. Lydia Carrasquillo Belvoir Res. Devel. & Eng Ft. Belvoir, VA 22060 703-664-5460

Mr. Michael Carroll Vermont Microsystems 11 Tigan Street Winooski, VT 05404

Ms. Stephanie Ann Carr SRC 180 Avenue of the Commons Suite 10 Shrewsbury, NJ 07702 201-542-6262

Mr. Chuck Carter HQ/AFSC/PLXC Andrews Air Force Base MD 20334

Mr. Michael Cart Dept of Nat'l Defense PM CALS, Rm 616 LSPL MajGen Geo. R. Perk Bldg. Ottawa Ontario, CN K1A0K2 819-994-9530

Mr. J. Cartwright Northrop Electronics 2301 W. 120th St. H510/N5 Hawthorne, CA 90251 213-600-5235

Mr. Arthur E. Casanova J D Kiser & Assoc 3702 Marlboro Way College Park, MD 20740

Ms. Pam J. Case Advent Systems, Inc. 7500 Greenway Ctr Dr Suite 500 Greenbelt, MD 21035 301-441-1999 Mr. Paul Casteleman McDonnell Douglas 5301 Bolsa Avenue Huntington Beach, CA 93647 714-896-3311

Mr. Paul Cataldo Department of the Navy Chief Of Naval Operations Washington, DC 20350-2000

Mr. John Chaffin Ford Aerospace 5A102 Ford Road Newport Beach, CA 92660 714-780-6106

Mr. Bradlee Chang Xerox 10200 Willow Creek Blvd. San Diego, CA 92131 619-695-7746

Mr. Paul Chan Northrop 1 Northrop Avenue Hawthorne, CA 90250 213-332-8514

Mr. John D. Chapman US Gov't Printing Office N Capitol & H St, NW Washington, DC 20401 202-275-2621

Mr. Joseph Chase U.S. Air Force HQAFSC/PLXC Andrews AFB, MD 20603

Mr. Robert A. Cheney Robert A. Cheney Assoc. 34 Ocean Blvd. North Hampton, NH 03862 603-964-6128 Mr. Liming Chen Xerox 701 S. Aviation Blvd Suite 222 El Segundo, CA 90245

Mr. Ruey Chen DTRC 1826 Bethesda, MD 20084 202-227-1683

Mr. David Chesebrough QUES Tech 7600 A Leesburg Pike Falls Church, VA 22043 703-760-1396

Mr. James J. Childs James J. Childs Assoc. 803 Timber Branch Pk Alexandria, VA 22302 703-549-4592

Mr. Michael Ciccarelli USAF SM ALC DPCT McClellan AFB, CA 95650

Mr. Angelo S. Cici Litton 5500 Canoga Ave. Suite 62 Woodland Hills, CA 91367 818-715-2399

Ms. Evelyn Clancy Computer Science Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Mr. Sol Clark Allied Signal Aerospace 118 Highway 35 Eatontown, NJ 07724 201-389-7729 Mr. Mark Clifford Ford Aerospace Ford Rd. Newport Beach, CA 92660 714-720-5144

Mr. Tim Clifford Booz-Allen & Hamilton 4330 East-West Hwy Bethesda, MD 20814 301-951-2446

Mr. Ernest Climenson Naval Ocean Systems Center Code 9612 San Diego, CA 92152 619-553-4807

Ms. Dena R. Cobb Marcon Industries 4733 Fletcher Ave. Ft. Worth, TX 76107 817-731-7437

Mr. W.G. Coberly System Resources Corp. 180 Avenue of the Commons Shrewsbury, NJ 07702

Mr. James W. Colangelo Advanced Technology, Inc. 2121 Crystal Drive Suite 200 Arlington, VA 22202 703-769-3593

Mr. Bob Colegero U.S. Navy NAVSEA CEL PA CM 2 RM 601 Washington, DC 20362

Mr. Edward Collins
Defense Logistics Agency
Cameron Station
Alexandria, VA 22304

Ms. Kathleen D. Connelly Boeing 1801 Alexander Bell A7-31 Reston, VA 22091 703-648-0768

Mr. Anthony C. Constable CAI/SISCO 845-E Quince Orchard Gaithersburg, MD 20878 301-840-5959

Cdr. Ed Corack Minigraph 12721 Taustin Lane Herndon, VA 22070 703-435-2556

Ms. Donna M. Coriand Lockheed 21157 Alaminos Drive Saugus, CA 91350 805-296-0589

Mr. David J. Coudert HQ BSD ALI 832 E. Pioneer Avenue Redlands, CA 92374 714-382-7821

Ms. Jonnesa Countess Army Missile Command AMSMI-RD-SE-TD-ST Redstone Arsenal, AL 35898 205-876-6980

Mr. Gary Counts McDonnell Aircraft P. O. Box 516 St. Louis, MO 63166 314-872-6729

Ms. Marilyn Courtot AIM 1100 Wayne Ave. Silver Spring, MD 20910 301-587-8202 Mr. David W. Covin Electri-Tech Intern'l Corp. 101 N Alfred St. Alexandria, VA 22314 703-684-5233

Mr. Al Cox Texas Res & Tech Found 5309 Marsh Creek Dr. Austin, TX 78759 512-346-4059

Mr. Virgil Crabtree Control Data Corp. 2970 Presidential Dr Suite 100 Fairborn, OH 45324 513-427-6412

Mr. James Craig Georgia Inst of Tech Aerospace Engineering Atlanta, GA 30332 404-894-3042

Mr. James R. Crane Long Beach Naval Shipyard Long Beach, CA 90822 213-547-7708

Mr. Bill Crase U.S. Army Info Sys Cmd. Attn: ASPL IP HQ, USAISC Fort Huachuca, AZ 85616

Mr. James R. Crawford IBM 9500 Godwin Drive 400/046 Manassas, VA 22110 703-367-3204

Ms. Kathryn Cremeen Santa Barbara Research 75 Coromar Drive Bldg B30-59 Goleta, CA 93117 805-562-4065 Mr. G. Crookston Dept of Nat'l Defense 101 Colonelby Drive NDHQ-DDIR Ottawa, CN K1A0K 819-998-7088

Mr. Kenneth Crow Western Data Systems 22120 Clarendon St. Woodland Hills, CA 91367 818/340-4041

Mr. Randy Crow Mentor Graphics Corp 15204 Omega Drive Suite 110 Rockville, MD 20850 301-990-1265

Mr. Dan Curry AT&T 2400 Reynolds Rd. Winston-Salem, NC 27106 919-727-6591

RADM Guy Curtis U.S. Navy Tne Pentagon Room 4E606 Washington, DC 20350

Ms. Cheryl Cushman Theodore Barry & Assoc. 50 Rockefeller Plaza New York, NY 10024

Mr. Ken Custer Aerojet Electrosys BLD 59A2 1100 W. Hollyvale, PO Box 296 Azusa, CA 91702 818-812-2164

Mr. James Dalgety
Defense Logistics Agency
Department of Defense, WSIAO
Cameron Station
Alexandria, VA 22304-6183

Mr. C. W. Daly Hazeltine Corporation 500 Commack Road Commack, NY 11725 516-266-5641

Mr. Earl Daniel Bendix Field Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. Joseph Dauksys Aerospace Ind Assoc 1250 Eye St., NW Suite 1100 Washington, DC 20005 202-371-8433

Ms. Barbara Davis Naval Sea Systems Cmd. 1411 Fern St. Arlington, VA 20020 703-692-1925

Mr. Randall Davis Tiuron Systems Inc. 2085 Hamilton Avenue San Jose, CA 95125

Mr. Rich A. De Gout General Dynamics 50-25 P.O. Box 2507 Pomona, CA 91769 714-868-6358

Mr. Richard O. De Shong Western Data Systems 22120 Claredon St. Woodland Hills, CA 91367 818-340-4041

Mr. James R. Deal U.S. Army Dugway Proving Grounds MT-TD Dugway, UT 84022 Mr. Kevin A. Deal Battelle 5100 Springfield Pike Dayton, OH 45431

Mr. Dennis M. Dean PM-CALS Ft. Monmouth, NJ 07703

Ms. Linda Dean U.S. Army PEO-STAMIS AS-PES Ft. Belvoir, 'VA 22026-5456

Ms. Twyla Dearing HQ/USAF/LEYE The Pentagon, Rm. 4A272 Washington, DC 20330

Ms. Cynthia K. Decker SAIC 1710 Good Ridge Dr. T-3 3 McLean, VA 22101 703-827-4854

Ms. Lisa Deeds Navy/DTRC Bethesda, MD 20084

Mr. Jesus E. Delagarza Northrop B2 8900 E. Washington BL/5413/ID Pico Rivera, CA 90660 213-948-8231

Ms. Sandra A. Dellibove Comptek Research 2121 Crystal Dr. Suite 700 Arlington, VA 22302 703-979-6200 Ms. Albina Delozier DataServ Inc Volt 380 Concorde Parkway Chantilly, VA 22021

Mr. Louis Derose Naval Air Eng. Center Training Div Code 124 Lakehurst, NJ 08733

Mr. George Desiderio Defense Sys & Prog Office 5109 Leesburg Pike Skyline #6, Rm. 306 Falls Church, VA 22041

Ms. Rose Di Geronimo Naval Sea Systems Cmd. 1411 Fern St. Arlington, VA 20020 703-692-1925

Ms. Gretchen Dickerson U.S. Air Force CALS MIO HQ AFSC/PLXC Andrews AFB, MD 20334-5000

Mr. Joseph G. DiGiacomo SAI Tech 1700 N Moore St. Suite 919 Rosslyn, VA 22209 703-527-9403

Mr. Jim Dillon Crosfield Design Systems 11401 Rupp Drive Burnsville, MN 55337

Mr. Ed Dlugosz System Resources Corporation 621 Shrewsbury Ave. Shrewsbury, NJ 07701 201-530-6767 Mr. William P. Doheney Lockheed 27242 Cabrera Avenue Saugus, CA 91350 818-847-9670

Ms. Jeanne Dole Martin Marietta Energy P.O. Box 20008 Bldg 2506, MS6309 Oak Ridge, TN 37831 615-576-0139

Ms. Linda Jo Dolny Silicon Graphics Inc. 2011 N. Shoreline Blvd 3L-210 Mountain View, CA 94039

Mr. Michael Domiano Dougla: Aircraft Co. 3855 Lakewood Blvd. MC 71-35 Long Beach, CA 90846 213-982-6224

Mr. Mark C. Donegan Sikorsky Aircraft 6900 Main St. M/S B102A Stratford, CT 06601 203-384-7372

Mr. Dennis Donovan US Army 15 Planning Res Dr. Mgt Office McLean, VA 22102

Ms. Donna M. Doriand Lockheed Aeronautical Systems 21157 Alaminos Dr. Saugus, CA 91350 818-847-9670

Mr. Jerry Doss Ordinance Ctr & School Aberdeen Proving Grd., MD 21005 301-278-5392 Mr. Richard Doull Paramax/Unisys 6111 Royalmount Ave. Montreal, Quebec, CN H4P 1K6 514-335-8591

Mr. Robert Downs Aerojet ElectroSystems Co. 1100 W. Hollyvale St. 179/6466 Azusa, CA 91702 818-812-1706

Ms. Susan Doyle 3709 Pepper Rd. MS 7669 Hunt Valley, MD 21030

Mr. Thomas Dragone Grumman Aircraft Systems 1111 Stewart Avenue Bethpage, NY 11714

Mr. Daniel J. Drake Logistics Management Inst 6400 Goldsboro Rd. Bethesda, MD 20817 301-320-2000

Mr. David M. Drake Applied Mgmt Sciences 962 Wayne Ave. Suite 701 Silver Spring, MD 20910 301-585-8181

Mr. Fullerton Drinton HQ Army Mat Cmd. 5001 Eisenhower Ave. Alexandria, VA 22333 703-274-8949

Mr. Michael Ducody HQ Army Materiel Command 5001 Eisenhower Ave. ATTN: AMCRE-CC Alexandria, VA 22333-0001 Ms. Petrea A. Durnan Allied-Signal 11100 N Oracle Rd. ME-2-2, Dpt 93904 Tucson, AZ 85740 602-469-6410

Mr. David L. Dutton Hughes Aircraft Co 0712060 Box 9939 Long Beach, CA 90810 213-513-3617

Mr. Kevin Dyer Financial Alternatives Eastgate Plaza 1st Fl Dellslow, WV 26531 304-296-1472

Mr. Mark Dyer Space Systems Div. P. O. Box 92960 ATTN: ALIS, Div 105 LA Air Force Base, CA 90009 213-643-1043

Mr. Preston Easley Northrop Corp. 1 Northrop Avenue 4500-82 Hawthorne, CA 90250

Mr. William Eason DCASMA El Segundo/GLAP 222 N. Sepulveda Blvd El Segundo, CA 90245 213-335-3333

Mr. Norm Eastwood Xerox Corp. 701 S Aviation Blvd ES A1-18 El Segundo, CA 90245 213-333-7913

Mr. E. Perley Eaton TRW Inc. One Federal Systems Rm 1213 Fairfax, VA 22033 703-968-1865 Mr. Fritz W. Eberle Agfa Compugraphic 200 Ballardvale St. Wilmington, MA 508-256-3397

Ms. Renee Edwards SWL, Inc 7926 Jones Branch Dr Suite 700 McLean, VA 22102 703-553-8976

Mr. Tom Eirich UNISYS 55 Broadway St. Cambridge, MA 02143 617-494-2367

Ms. Marion L. Elledge Graphic Comm Ass'n 1730 N Lynn Suite 604 Arlington, VA 22209 703-841-8160

Mr. Mel Ely Naval Ed, Trng-PAC 921 W. Broadway San Diego, CA 92132 619-532-1334

Mr. Charles Embrey Engrs & Economics Res 1593 Spring Hill Rd. Suite 300 Vienna, VA 22182 703-761-3814

Mr. Greg Erickson Dept of Nat'l Defense 101 Col. By Dr. Ottawa, Ontario, CN K1A0K2 819-995-0262

Mr. Dave Evans McDonnell Aircraft Co. PO Box 516 D.090, B279/2 St. Louis, MO 63166 314-233-1485 Mr. Jeffrey D. Everst USMC 1300 Wilson Blvd. Code PSL-P Rosslyn, VA 22192 202-694-1630

Ms. Sandra D. Facon Douglas Aircraft Co. MS 71-35 3855 Lakewood Boulevard Long Beach, CA 90846 213-496-6419

Mr. Fred Fagan Allied Signal-Air Res 2525 W 190th St. Torrance, CA 90249 213-512-3753

Mr. Ulf Fagerquist Digital Equipment Corp. 153 Taylor Street Littleton, MA 01460

Mr. Paul Falk Johns Hopkins Univ Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Mr. C. Fange The Boeing Co. 3801 S. Oliver Wichita, KS 67210

Mr. Claude J. Farinha Logistic Systems Architects 3310 Moorewood Ct. Sacramento, CA 95821 916-487-0881

Ms. Michaelene Farmer Douglas Aircraft Co 3855 Lakewood Blvd. MC 52-90 Dept. 359 Long Beach, CA 90846 213-593-8462 Ms. Jill Farrell Lawrence Livermore Labs. P. O. Box 808, MS/L-542 Livermore, CA 94550

Mr. Anthony Farrington Allied-Signal Aerospace PO Box 5227 74-51/1801K Phoenix, AZ 85010 602-731-5241

Mr. Francis B. Fay TRW PO Box 1310 952/105 San Bernardino, CA 92402 714-382-2236

Lt. Marion Fedorshak OSAD(A&L) Office Secretary of Defense The Pentagon, Rm. 2B322 Washington, DC 20301

Mr. Thomas A. Feeley Litton Computer Svc 1300 Villa St. Mountain View, CA 94039 415-966-7599

Mr. Tad A. Feinstein Allied-Signal Aerospace 1300 E Joppa Rd. Dept 463 Baltimore, MD 21204 301-583-4385

Mr. Howard Feldmesser Johns Hopkins Univ Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Mr. Charles Ferguson U.S. Army CSDA P.O. Box 1578 St. Louis. MO 63188 Mr. Harold Ferguson The Technigroup Inc. 17320 Redhill Suite 250 Irvine, CA 92714 714-557-0844

Ms. Monica A. Ferguson DRC 2751 Stone Hollow Dr Vienna, VA 22180 703-556-1373

Mr. John W. Ferrill Summit Tech., Inc. 6551 Loisdale Ct. Suite 600 Springfield, VA 22150 703-922-5226

Ms. Carolyn A. Ficken General Dynamics 11096 Avenida Maria San Diego, CA 92129

Mr. Harold B. Field, Jr. Martin-Marietta-Orlando PO Box 555837 MP 552 Orlando, FL 32855 407-356-6307

Mr Ben Fierz Oerlikon 225 Seminaire Blvd S St. Jean, Quebec, CN J3B8E 514-358-2000

Mr. Charles W. Finch AT&T PO Box 20046 71GC049380(WIG55) Greensboro, NC 27420 919-279-3305

Ms. Judy Fincher Honeywell Federal Syst 7900 Westpark Dr. McLean, VA 22102 703-827-3879 Mr. Matt Fisher U.S. Army Ft. Monmouth, NJ 07703

Mr. David Fitzgerald Data Systems 1100 W. Hollyvale Azusa, CA 91702 818-812-1056

Mr. Dennis Fitzgerald Computer Science Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Ms. Judy Fleming General Dynamics F.O. Box 748 Mail Stop 9378 Ft. Worth, TX 76101 817-882-5535

Mr. Randall Fleming Lockheed 554 51-90 P.O. Box 3504 Sunnyvale, CA 94088 408-742-1557

Mr. J. Bradley Flippin Raytheon Service Co. 2341 Jefferson Davis Hwy Suite 1200 Arlington, VA 22202 703-685-2337

Mr. Lance A. Flitter DTRC Code 1822 Bethesda, MD 20084 202-227-3379

Mr. Nilo Florence Federal Admin Assoc. P.O. Box 25082 AAC 421 Oklahoma City, OK 73125 Ms. Gwendolyn Flowers Automation Res Syst 4480 King St. Alexandria, VA 22302 703-824-6405

Mr. Robert Flowers Hughes Aircraft Co P.O. Box 9399 4C620 A01 Long Beach, CA 90810 213-513-3143

Mr. David Fogg Johns Hopkins Univ Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Mr. Samuel N. Foner Johns Hopkins Univ Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Mr. Edward A. Ford RAF MOD UK (AIR) Neville House, Rm. 511 Page Street London SW1, ENGLAND

Mr. Jon A. Ford Lockheed Missiles & Space Co. 91 B564 P.O. Box 3504 Sunnyvale, CA 94088 408-756-9265

Mr. Don Forscht Computer Science Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-737-0760

Mr. Reynaldo Forte, Jr Belvoir Res Develop/Eng Ft. Belvoir, VA 22060 703-664-5460 Mr. Steven Fortner Imagenet Systems, Inc. 200 Brevard Ave. Cocoa, FL 32922 407-632-4333

Mr. G.G. Foth Allison Transmission Div PO Box 894 E11 Indianapolis, IN 46077 317-242-2743

Ms. Dorothy Foulk Rockwell Int'l 2201 Seal Beach Blvd P.O. Box 2515 Seal Beach, CA 90740 213-797-2935

Mr. Dennis Fox DCASR LA RCQ MZ 13DCAS P.O. Box 85357 San Diego, CA 92138 619-573-8909

Ms. Paula G. Fox Fox Assoc 6538 Palisades Dr. Centreville, VA 22020 703-968-5820

Ms. Jan Fradin Versatec/Xerox 2710 Walsh Ave. M/S 3-14 Santa Clara, CA 95051 408-748-3066

Mr. Donald Frahnstock AIM, Inc. 219 E Main St. Mechanicsburg, PA 17055 717-766-3461

Ms. Andrea Frankel Hewlett Packard 16399 W. Bernardo Drive Bldg. 61U, Dept. 6, 584 San Diego, CA 92127 619-592-4664 Ms. Carol Frederick Westinghouse 111 Schilling Rd. MS 7053 Hunt Valley, MD 21030 301-584-3148

Mr. Lee French U.S. Air Force Air Force Systems Command HQ AFSC/R68C Andrews AFB, MD 20603

Mr. Norm R. Frey Electronic Data Systems 700 E Firmin St. M.S. HOF-M Kokomo, IN 46902 317-451-4284

Mr. Kevin Fry Naval Sea Logistics Cntr PO Box 2060 Mechanicsburg, PA 17055 717-790-2958

Mr. Abie Fuller Defense Logistics Agency DLA-SEP Cameron Station Alexandria, VA 22304

Mr. Joseph J. Fuller DTRC Code 182.3 Bethesda, MD 20084 202-227-1358

Mr. Vernon Funkhouser Air Force 6515 LTS/MATV 6510 ABW/MSCT Edwards AFB, CA 93523 805-277-2050

Mr. Mark R. Funt Convergent Solution 100 Metro Park South Laurence Harbor, NJ 08878 201-290-0090 Ms. Cita Furlani NIST Bldg. 220/Rm. A129 Gaithersburg, MD 20899

Mr. James J. Gaeschke McDonnell Douglas Miss Sy Box 516 Dept E133, MC1063483 St. Louis, MO 63166 314-233-7462

Mr. Jonathan S. Gal-Edd McDonneil Douglas 1801 Alexander Bell Reston, VA 22091 703-648-0674

Mr. Elzie Gale Logistic Systems Architect 3800 Watt Avenue Suite 210 Sacramento, CA 95821 916-348-2270

Mr. Ivan Galysh HQ Army Mat Comm 5001 Eisenhower Ave. Alexandria, VA 22333 703-274-8325

Mr. Val Gannotti Minigraph, Inc. Suite 3B/2004 Sproul Road Broomall, PA 19008 215-359-1300

Mr. James G. Ganz Sanders Assoc. 95 Canal St. C.S. 2004 Nashua, NH 03061 603-885-7300

Mr. Gary Gardner Martin Marietta PO Box 1260 XL 0750 Denver, CO 80201 303-977-2549 Mr. Geoffrey Gardner D. Appleton Co., Inc. 3028 Javier Road Suite 300 Fairfax, VA 22031 703-573-7644

Mr. Bruce Garner Lawrence Livermore Nat'l Lab 7000 East Ave. L-542 POBox 808 University of California Livermore, CA 94550 415-422-8730

Mr. Joe Garner Navy/DTRC Code 1826 Bethesda, MD 20084 301-227-3348

Mr. Charles Garverick Consultant 4333 Ashford Lane Fairfax, VA 22032 703-425-6215

Mr. Helmut Gaus Smiths Industries Assoc. 7-11 Vreeland Rd Florham Park, NJ 07932

Mr. Dane Gayle LSA 3800 Watt Avenue Sacramento, CA 95630 916-348-2270

Mr. Calvin O. Gehan Honeywell PO Box 888 MN67-2B07 Minneapolis, MN 55440 612-593-4500

Ms. Sherry Gelenius Accurate Information Systems 3000 Hadley Rd. S. Plainfield, NJ 07080 Ms. Pam Gennusa Datalogics 325 W. Huron St. Chicago, IL 60610

Mr. Eric C. Gentsch Logistics Management Inst 6400 Goldsboro Rd. Bethesda, MD 20817 301-320-2000

Mr. Alan German Boeing Computer 1700 N Moore St. 20th FI Arlington, VA 22209 703-558-3225

Mr. George Gianios Navy Pub. & Printing Serv. Ofc 700 Robbins Ave. Bldg. 4D Philadelphia, PA 19111 215-697-2976

Mr. Stephen Giese Boeing Computer 1801 Alexander Bell Reston, VA 22091 703-648-0744

Mr. Gene Gipson Sigma Plus, Inc. 4001 Williamsburg Ct Fairfax, VA 22032 703-591-0733

Mr. John Giroux USMC MCTSSA Camp Pendleton, CA 92055 619-725-2159

Mr. Al Giske Northrop Corp Y12 500 E Orangethorpe Avenue Anaheim, CA 92801 714-441-3944 Mr. Randy Goggin Navy Gage and Stds P.O. Box 2426 Pomona, CA 91769 714-620-0557

Mr. Martin Golanka General Electric Co. Electronics Park Syracuse, NY 13221 315-456-2093

Mr. Oscar Goldfarb SAF/ALG The Pentagon Room 865 Washington, DC 20310

Mr. Bernard Gollomp Allied Signal Rt 46 Teterboro, NJ 07608 201-393-2505

Mr. Robert M. Goodman Boeing Computer Services PO Box 33126 Philadelphia, PA 19142 215-591-4447

Mr. William Gorham Department of Defense, WSIAO DLA, Cameron Station Alexandria, VA 22304-6183

Mr. Stewart C. Gosney ERC International 3211 Jermantown Rd. MS 784A Fairfax, VA 22030 703-246-0376

Mr. Philip C. Gould General Dynamics PO Box 748 MF 4040 Ft. Worth, TX 76101 817-935-3237 Mr. Luc Goyette Oerlikon 225 Seminaire Blvd S St. Jean, Quebec, CN J3B8E 514-358-2000

Mr. Robert G. Graff Westinghouse Electric PO Box 1488 MS9910 Annapolis, MD 21404 301-260-5712

Ms. Elizabeth Gramoy GSA General Services 2022 Camino Del Rio N. San Diego, CA 92108

Mr. John T. Grasso W Virginia Univ 415 Knapp Hall 6031 Morgantown, WV 26506 304-293-2431

Mr. Glenn Graves Northrop 8900 E. Washington Blvd. Pico Rivera, CA 90660 213-942-4572

Mr. David Greathouse Bendix Field Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. Joe Greco Syscon Corp. 3990 Sherman St. San Diego, CA 92110 619-296-0085

Mr. Michael Greene TRW-Systems Div 251 Prosperity Ave. Bldg W1/4514 Fairfax, VA 22031 703-734-6131 Ms. Sandra S. Green I-Net, Inc. 11426 Rockville Pike Suite 108 Rockville, MD 20852 301-230-1320

Mr. John Greenwald Pacmis Test Cen Code 3133 Point Mugu, CA 93042

Mr. Harry L. Gregory Systems Res & App Corp 2000 15th St. N A-6 Arlington, VA 22201 703-558-8451

Ms. Karen Gregory
DLA CALS Office
6301 Little River Turnpike
Beauregard Square, Suite 310
Alexandria, VA 22312

Mr. Gregory L. Griffin Air Force HQ AFSC/PLKC Andrews AFB, MD 20772 301-981-3915

Mr. Larry Griffin WSIG (A&L) The Pentagon Room 2B322 Washington, DC 20310

Mr. Eugene A. Grinstead Consultants Int'l 5932 Oakdale Rd. McLean, VA 22101 703-536-3742

Mr. Roy Gronau Infotec Development 35D5M Cadillac Avenue Costa Mesa, CA 92626 714-241-8254 Mr. Grosso Boeing Computer Services P.O. Box 33126 Philadelphia, PA 19142

Mr. Jack Grubb McDonnell Douglas Corp. Dept. E257, Hqts. 3 N, MS/329 P. O. Box 516 St. Louis, MO 63166 314-234-6105

Mr. William Gruttke McDonnell Douglas AIS Co. P. O. Box 516 MC-27111380 St. Louis, MO 63166 314-234-5264

Mr. Ralph Guditz OCTAL Inc. 450 East Middlefield Rd. Mountain View, CA 94043

Mr. Vince Guidice Goddard Space Flight Ctr. Greenbelt, MD 20071 301-286-5700

Mr. Nicholas Guletsky TRW Inc. One Space Park 134 5858 Redondo Beach, CA 90278 213-217-3018

Mr. Richard A. Gunkel Sigma Plus, Inc. 4001 Williamsburg Ct Fairfax, VA 22032 703-591-0733

Mr. William Hagye NSC T-2134 Ft. George G. Meade, MD 20755 301-859-6004 Mr. Robert W. Hales Bendix Avelex 200 Laurentien Blvd Montreal, CN H4M2L 514-744-2811

Mr. Robert Halfhill Bendix Feild Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. Robert Hallam AAI Corp. 2251 Knoll Crest Pl. Westlake Village, CA 91361 805-496-9728

Mr. Don Hall Defense Logistics Agency Cameron Station Alexandria, VA 22304-6183

Mr. Dean Hansen INFOTEC Development Inc. 3505-M Cadillac Ave. Costa Mesa, CA 92626 714-241-8254

Mr. James S. Hanson Gencorp Aerojet One 8323 1100 W. Hollyvale St. Azusa, CA 91702 818-812-1369

Mr. Martin Hardy Magnavox 2829 Maricopa Torrance, CA 90503 213-618-1200

Mr. Butch C. Harper Newport News Shipbuilding 4101 Washington Ave. Dept C69, B520, 4 FI Newport News, VA 23607 804-380-2186 Ms. Lydia A. Harrell Naval Aviation Depot Code 09111 Bldg E69 NAS Norfolk, VA 23511

Mr. Harlan Harrison FMC Corp. Naval Sys Div 1300 South 2nd Street Minneapolis, MN 55459

Mr. Robert Harrison U.S. Navy NAVAIR SYSCOM 4 Washington. DC 20361

Mr. Edward Hassinger Cubic Corp. 9333 Balboa Avenue San Diego, CA 92123 619-277-6780

Ms. Suzan K. Hatch IBM 9600 Diagonal Hwy. 004F Boulder, CO 80303 303-924-9661

Ms. Fran M. Hathaway Naval Ordnance Station Code 370A Indian Head, MD 20662 301-743-4250

Mr. Dom Hawker PMTC Code 3153 Point Mugu, CA 93004 805-989-8971

Mr. Karl R. Heiser American Systems Corp 14200 Pk Meadow Dr Chantilly, VA 22021 703-418-2006 Mr. John J. Helisek ELS, Inc. 5201 Leesburg Pike Suite 510 Falls Church, VA 22041 703-284-7612

Mr. Ian Henderson Hollandse Signal Apparat Postbus 42 Gdhengeld, Netherlands

Mr. William Henke Naval Air Systems Washington Navy Yd. Bldg 220-2/Air71333B Washington, DC 20374 202-433-3055

Mr. K.G. Henrikson Lockheed Aero Sys. P.O. Box 551 MS 7227-90 Burbank, CA 91520 818-847-8003

Mr. William I. Henry Boeing Aerospace PO Box 3999 9YI9 Seattle, WA 98124 206-657-6666

Mr. Denny Henschel Nat'l Sys Mgmt 4600H Pinecrest Of P Alexandria, VA 22312 703-521-9356

Mr. Edward Herl STS Information Systems 1101 King St. Suite 601 Alexandria, VA 22314 703-838-9246

Mr. John A. Hermann DCASMA El Segundo/GLAP 222 N. Sepulveda Blvd El Segundo, CA 90245 213-335-3330 Ms. Beth T. Herschman Grumman 6862 Elm St. Suite 500 McLean, VA 22101 703-760-0319

Ms. Diana Hickey Defense Comm. Agency 8th & Courthouse Rd. Arlington, VA 22204 703-692-7667

Mr. Wayne Hierlmaier Honeywell 10400 Yellow Cir Dr. MS/MN38-5500 Minnetonka, MN 55343 612-931-4652

Mr. G. John Higgins Vitro 14000 Georgia Ave. MS/A-404 Silver Spring, MD 20906 301-738-4607

Mr. William Hill OAO Corporation 7500 Greenway Ctr. Greenbelt, MD 20770 301-345-0750

Mr. Jerry Hinzman Dept of the Navy 1911 Jefferson Davis Hwy Washington, DC 20376 202-695-2814

Mr. Robert I. Hisel Grumman Data Systems 6862 Elm St. Suite 500 McLean, VA 22101 703-760-0131

Mr. Ron Hodge Booz-Allen & Hamilton 4330 East-West Hwy Bethesda, MD 20814 301-951-2446 Mr. David C. Hoefner Philadelphia Electric Co 2301 Market St MC S8-1 Philadelphia, PA 19101

Mr. Mark M. Hoffman USAF AFHRL/LRL WPAFB Dayton, OH 45433 513-255-3871

Mr. Peter F. Holbrook OSD Pentagon Rm 3B 740 Arlington, VA 20301 202-695-8358

Mr. G.L. Hollander Hollander Associates P.O. Box 2276 Fullerton, CA 92633 714-879-9000

Mr. Randy Hollingsworth Rockwell Int'l 400 Collins Rd NE Cedar Rapids, IA 52498

Mr. Arthur Holmes, Jr. Automated Sciences Group Inc. 700 Roeder Road Silver Spring, MD 301-587-8750

Mr. Mark Holthaus Rockwell Int'l F820 12214 Lakewood Blvd Downey, CA 90241 213-922-4165

Mr. Wayne Honega NSWSES NSDSA 5H100 Bldg 5 Port Hueneme, CA 93043 805-982-3442 Mr. Tom Hood IBM 1301 Piccard Dr. 862/218 Rockville, MD 20850 301-640-5886

Mr. Parker Hooper Jr. Naval EOD Tech Cntr Indian Head, MD 63141

Mr. Harvard Hopkins OAO Corporation 7500 Greenway Ctr. Greenbelt, MD 20770 301-345-0750

Mr. Richard A. Horne Lockheed P.O. Box 3574 Sunnyvale, CA 94083 408-742-2198

Mr. Michael Horoschak Naval Sea Logistics Ctr 5450 Carlisle Pike PO Box 2060 Mechanicsburg, PA 17055 717-790-5124

Mr. Steve Horvath Dept of Nat'l Defense 101 Colonelby Dr. NDHQ-DDIR Ottawa, CN K1A0K 613-998-7088

Mr. Robert Houts U.S. Navy

Mr. Scott B. Huchingson Digital Equipment Corp. 721 Emerson Rd. Creve Coeur, MO 63141 Ms. Gail Hudson AF Human Resources Lab AFHRL/LRC Wright Patterson AFB, OH 45433

Mr. Robert G. Huff Advanced System Tech. 766 Shrewsburg Ave. Tinton Falls, NJ 07724 201-747-0291

Mr. Lyle Hull CSA/IRNS Tech Services Div 2022 Camino Del Rio N Suite 660 San Diego, CA 92108

Mr. Randy Huíse Texas Instruments 13500 N. Central Expwy. MS-16 Dallas, TX 75265

Mr. Mike Hunting Kruse Industries Inc. P.O. Box 245 Downingtown, PA 19335

Mr. J. Hunt Boeing Computer Services P.O. Box 33126 Philadelphia, PA 19142

Mr. Mike Hurn Texas Instruments P. O. Box 869305 MS 8506 Plano, TX 75086 214-575-6065

Ms. Lisa D. Hyatt IBM Rt. 17C M/D 0315 Owego, NY 13827 607-751-5919 Mr. J. Incalcaterra Space Systems Div P.O. Box 92960/ALII Los Angeles, CA 90009 213-643-0142

Mr. Mel Indyk General Dynamics 12101 Woodcrest Exec St Louis, MO 63141 314-851-8920

Mr. Vincent Irby
U.S. Government
PM CALS
Attn: ASPES CA
Fort Monmouth, NJ 07703

Ms. Eileen Irons Naval Pubs & Forms Ctr 5801 Tabor Ave. NPFC 44-1 Philadelphia, PA 19120 215-697-2661

Ms. Norma Jackson ALI CALS SD/ALI - P.O. Box 92960 Los Angeles AFB Los Angeles, CA 90009 213-643-0142

Mr. Bob Jakubik Computer Science Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Mr. Don Jaycox Cubic Corporation 8-A3 9333 Balboa Avenue San Diego, CA 92123 619-277-6780

Ms. Janice Jeffers IBM 18100 Frederick Rd. Gaithersburg, MD 20879 301-240-6048 Mr. George Jenkins Vitro Corp. 14000 Georgia Ave. Silver Spring, MD 20906 301-231-3401

Mr. Richard Jennings Cadkey 440 Oakland St. Manchester, CT 06040 203-647-0220

Mr. Ronald Jennings Ferranti International %Westinghouse/Desco Box 1693 MS-8710 Baltimore, MD 21203 301-379-2471

Mr. Thomas A. Jindra Ford Aerospace Corp. Ford Road MS/5D Newport Beach, CA 92660 714-720-7127

Ms. Barbara L. Johnson Trident Data Systems 5933 W. Century Blvd Suite 700 Los Angeles, CA 90045 213-645-6483

Mr. Richard C. Johnson Grumman Corp. 1000 Wilson Blvd. Suite 2100 Arlington, VA 22209 703-276-4968

Mr. Robert Johnson General Dynamics Elec. 5011 Kearny Villa Rd. MZ 7223-A P.O. Box 85310 San Diego, CA 92138 619-425-1312

Mr. Sean Johnson STS Information Systems 1101 King St. Suite 601 Alexandria, VA 22314 703-838-9246 Mr. Wayne Johnson U.S. Government PM CALS Attn: ASPES CA Fort Monmouth, NJ 07703

Mr. Anthony Jones TAMSCO 4041 Fowder Mill Rd. Suite 500 Calverton, MD 20705 301-937-1799

Mr. Charles W. Jones DOD 9800 Savage Rd. T21 Ft. Meade, MD 20755 301-859-6066

Mr. Dwayne Jones Rockwell Int'l 3370 Miraloma Avenue P.O. Box 3105 Anaheim, CA 92803 714-762-2606

Mr. Jack Jones Defense Tech. Info. Cntr. Cameron Station Alexandria, VA 22304 703-274-7661

Mr. James Jones Hughes Aircraft Co Bldg. R4/MS 558 Los Angeles, CA 90009

Ms. Pat Jones US Army Attn: ATCL-OPA Ft. Lee, VA 23801 804-734-1621

Mr. William Jones Naval Sea Logistics Cntr PO Box 2060 Mechanicsburg, PA 17055 717-790-2958 Mr. Eric L. Jorgensen DTRC Head-Code 1822 Bethesda, MD 20084 202-227-1622

Mr. M. Journey Precision Visuals 6260 Lookout Rd. Boulder, CO 80301

Mr. Tony Joyce Naval Facilities Command 200 Stovall St. Alexandria, VA 22332 202-325-0850

Mr. Henry G. Judd UNISYS 8201 Greensboro Dr. 11N22 McLean, VA 22102 703-847-3552

Mr. John Junod DTRC Code 1822 Bethesda, MD 20084 202-227-1029

Mr. Robert Jurick U.S. Air Force ASD/SCEA Wright Patterson AFB, OH 45433

Mr. Shy'ming Ju U.S. Army PM-CALS AS-PES-CA Ft. Monmouth, NJ 07703-5000

Mr. Greg E. Kaebnick Ass'n for Info. & Image 1100 Wayne Ave. Suite 1100 Silver Spring, MD 20910 301-587-8201 Mr. Kimball Kahn IDX 21515 Ridgetop Circle Sterling, VA 22170

Mr. A. J. Kalimanos Integrated MicroComputer 2 Research Place Rm. 320 Rockville, MD 20850 301-948-4790

Mr. Ben Kassel Navy/DTRC Bethesda, MD 20084

Mr. Hal Kato Computer Sciences 711 Daily Dr. Camarillo, CA 93010 805-989-9641

Mr. Mark Kaufman Navy Fleet Analysis Ctr. Nav Wpns St/Code 3143 Corona, CA 91720 714-736-5451

Mr. William Kawamura GSA Irms P.O. Box 25526/7KT-8 Denver, CO 80225

Mr. Colm Keane Dept of Nat'l Defense 101 Col. By Dr. Ottawa, Ontario, CN K1A0K 613-995-0262

Mr. Donald Keaney CSDL 555 Technology Sq. Cambridge, MA 02138 617-258-2179 Mr. Jerry Keba Viereck 10220 Old Columbia Rd. Columbia, MD 21046

Mr. Joe Kedzierski Lockheed Aeronautical Sys 7333 458 Marietta, GA 30063

Mr. Glenn Keenan Pacmis Test Cen Code 3153 Point Mugu, CA 93042 805-989-8971

Mr. William Kee NKF Engineering Inc. 2550 Ellsmere Ave. Suite J Norfolk, VA 23513 804-857-0159

Ms. Deborah Kelfer Xerox Corp. 101 Continental Blvd. MS/ESXC-483 El Segundo, CA 90245 213-333-2494

Mr. John R. Kelley General Dynamics 2341 Jefferson Davis Hwy. Suite 395 Arlington, VA 22202 703-769-0326

Mr. W.A. Kellogg Wang Laboratories One Industrial Way Lowell, MA 01851

Mr. Michael D. Kennedy ELS, Inc. 5201 Leesburg Pike Suite 510 Falls Church, VA 22041 703-284-7622 Mr. Ralph Kennedy U.S. Navy Headquarters Marine Corp. Washington, DC 20380

Mr. Joseph Kenney General Dynamics PO Box 748 MF 1363 Ft. Worth, TX 76101 817-763-3351

Mr. Ward Kerr Ford Aeronutronic Div. Ford Road Newport Beach, CA 92691 714-720-4827

Mr. Joseph E. Keslin Systems Compatibility Co 401 North Wabash Suite 600 Chicago, IL 60611 312-329-0700

Mr. Harry P. Kessler Mission Engineering Corp. 6305 Ivy Lane Suite 400 Greenbelt, MD 20770 301-982-0202

Mr. Hamid Khoshnevis Xerox 701 S. Aviation El Segundo, CA 90245 213-33-7358

Mr. Bob Kidwell Syscon Corp 1000 Thomas Jefferson St., NW Washington, DC 20007 202-342-4090

Mr. Phil Kienlen Martin Marietta Energy P.O. Box 20008 Bldg 2506, MS 6309 Oak Ridge, TN 37831 615-574-6982 Mr. Robert Kiggins SCRA 5300 Terminal Blvd. North Charleston, SC 29418

Mr. Stephen M. Kimmey Tandem Computers 19191 Vallco Parkway Loc 4-21 Cupertino, CA 95014 408-725-5447

Ms. Martha Anne King VSE Corp 2760 Eisenhower Ave. Alexandria, VA 22314 703-329-2632

Mr. George Kirchner Xerox 701 South Aviation Blvd. ES A1-18 El Segundo, CA 90245 213-333-7247

Ms. Marsha Kirschner Computer Sciences Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Mr. John D. Kiser J D Kiser & Assoc Box 908 Sherwood Forest, MD 21405 301-849-8542

Ms. Gladys Marie Kiss TRW DH6-2826 One Space Park Redondo Beach, CA 90278 213-217-3866

Mr. Al Klein Martin Marietta Energy Box 2003, MS 7191 Bldg K-10001 Oak Ridge, TN 37831 Mr. Mel H. Klein IBM 1301 Piccard Dr. 862/215 Rockville, MD 20850 301-640-5905

Mr. Phil M. Knapp AAI Box 126 200/106 Hunt Valley, MD 21130 301-628-3734

Mr. Kenneth Knollenberg Long Beach Naval System Code 1101 Long Beach, CA 90822 213-547-6551

Mr. Pat Kofalk U.S. Army HQ AMC 5001 Eisenhower Avenue AMCRE Alexandria, VA 22332

Mr. Paul Koshetar Deloitte Haskins & Sells 1001 Pennsylvania Ave. NW Suite 350 Washington, DC 20004 202-467-2444

Mr. Donald C. Koski Pratt & Whitney PO Box 109600 MS 717-51 W Palm Beach, FL 33410 407-796-3324

Mr. Vernon Ko Veda Incorporated 1755 S Jefferson Davis Hwy Suite 312 Arlington, VA 22202 703-553-9770

Mr. Peter Kozak GE Aerospace Building 98 Blue Bell, PA 19422 Ms. Barbara A. Kramer Raytheon Co Equip Div 528 Boston Post Rd. Box 5-2-107 Sudbury, MA 01776 508-440-4012

Mr. Carl F. Kress U.S. Army Eng Div SO PAC 630 Sansome St. Room 720 San Francisco, CA 94111

Mr. R.C. Krishfield Rockwell Int'l 12214 Lakewood AE44 Downey, CA 90241 213-922-2105

Mr. James R. Kronquist DOD T21 Ft. G. G. Meade, MD 20755 301-859-6066

Mr. Jim Kruse Kruse Construction Company P.O. Box 245 104 Gallagherville Road Downington, PA 19335 215-269-9220

Mr. John Kuhn Eldyne, Inc. 4701 Columbus St. Virginia Beach, VA 23462 703-456-0700

Mr. Ed Kuzia Textron/Lycoming 550 Main St. Stratford, CT 06497 203-385-1455

Mr. Daniel J. Kuzma Martin Marietta Data Sys 103 Chesapeake Pk Pl M.P. 93 Baltimore, MD 21220 301-682-2942 Mr. David Kyle Naval Air Systems Comm. 1421 Jefferson Davis Hwy. Rm. 180, JP2, AIR-4114 Arlington, VA 20361 703-692-5661

Mr. Richard Laister Sikorsky Aircraft 6900 N Main St. Stratford, CT 06601 203-386-6573

Mr. Gary Lake FAI 5 Choke Cherry Rd. Rockville, MD 20850 301-258-5130

Mr. Mel Lammers HQ AFLC/SCTA Air Force Logistics Command Wright Patterson AFB, OH 45433 513-257-3085

Mr. Donald Lanzinger The Aerospace Corporation P.O. Box 92957 MS-M8174 Los Angeles, CA 90009 213-336-3107

Mr. Norman Larkin CSDL 555 Technology Sq. Cambridge, MA 02138 617-258-2179

Mr. Lou Lartique CACI 1735 Jefferson Davis Hwy Arlington, VA 22202 703-567-8504

Mr. Victor Lawnicki Ford Aerospace P.O. Box A Ford Rd. Newport Beach, CA 92658 714-720-6927 Mr. Mark Lawrence Robins AFB WR-ALC/QL Robins AFB, GA 31098 912-926-0152

Mr. Ron J. Lawrence Allied-Signal Aerospace 255 Attwell Dr. 254 Rexdale, Ontario, CN M9W6L 416-675-1411

Mr. Steve Lawrence Mentor Graphics Coro 15204 Omega Dr. Suite 110 Rockville, MD 20850 301-990-1265

Mr. Horace Layton Computer Sciences Corp. 1 N. Revmont Dr. Suite 30 Shrewsbury, NJ 07701 201-389-3410

Mr. Bernard Lazorchak Joint Comm. on Printing S-151, The Capitol Washington, DC 20510

Mr. Raymond Le Beau DTRC Code 182.3 Bethesda, MD 20084 202-227-1372

Ms. Mary Lebus U.S. Army PM CALS Attn: AS-PES-CA Ft. Monmouth, NJ 07703

Mr. Harry Lee Pacmis Test Center Code 0130 Point Mugu, CA 93042 805-989-7801 Mr. M. Lee Accurate Info Systems 3000 Hadley Rd. S. Plainfield, NJ 07080

Mr. Robin Lee CAD Centre Inc. High Cross Madingley Rd. Cambridge, England, CB34E

Ms. Kim Leftwich OAO Corp. 7500 Greenway Ctr. Greenbelt, MD 20770 301-345-0750

Mr. Bruce Lepisto WSIG (A&L) The Pentagon Room 2B322 Washington, DC 20310

Mr. Andrew J. Lesko Systems & Logistics Corp. P. O. Box 4610 Norton AFB, CA 92409 714-889-8803

Mr. Bill Leslie Auto-Trol Technology 4900 Seminary Rd. Suite 800 Alexandria, VA 22311 703-578-6950

Mr. David N. Lewis Presearch, Inc. 2361 S Jefferson Davis Hwy. Arlington, VA 22202 703-553-2700

Mr. Frank Lewis U.S. Army HQ AMC 5001 Eisenhower Avenue AMCRE Alexandria, VA 22333 Mr. Marvin L. Lewis E-Systems PO Box 1056 CBN 180 Greenville, TX 75401 214-457-4717

Ms. Rita Lewis U.S. Army PEO-STAMIS AS-PES Ft. Belvior, VA 22026-5456

Mr. David M. Liebergott GSA 514 Crystal Mall 4 GSA-FSS-FCOE Washington, DC 20406 703-557-8439

Mr. Kenneth W. Lindstrom LMI 2344 Sode St. Bethesda, MD 20817 301-320-2000

Mr. James F. Linke Defense Logistics Agency 34 Civic Ctr Plaza P.O. Box C12700 Santa Ana, CA 92712 714-836-2985

Ms. Lynne Lins Lins & Associates 5150 Donna Avenue Tarzana, CA 91356 818-996-5217

Mr. Larry Linton Litton-Amecom Div 5115 Calvert Rd. College Park, MD 20740 301-454-9232

Mr. Philip N. Livingstone Battelle 2101 Wilson Blvd. Suite 800 Arlington, VA 22201 703 528 6603 Ms. Jean Logan OAC Corp. 7500 Greenway Ctr. Greenbelt, MD 20770 301-345-0750

Mr. Ben Lohr Pymatuning Group 2000 N 15th St. Suite 707 Arlington, VA 22201 703-243-3993

Mr. Eddie London DOD Pacific Missile Test Ctr Career Development Div Code 0410 Point Mugu, CA 93045

Mr. Dale Long Computer Sciences Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Ms. Becky Lonneman HQ/USAF/LE-I The Pentagon Washington, DC 20330-5130

Mr. Ken T. Lorson McDonnell Douglas Co 3855 Lakewood Blvd MC 71-35 Long Beach, CA 90846 213-593-6189

Mr. Gino Lostracco Naval Air Development Center 30E1 Warminster, PA 18974

Mr. George M. Lotz Allied/Signal Comm. Div. 1300 E. Joppa Rd. Towson, MD 21204 Mr. Joe Lougheed Lockheed P.O. Box 551 Burbank, CA 91504 818-847-1609

Mr. Thomas M. Loughney Venntronix, Inc 167 Ave of the Common Shrewsbury, NJ 07702 201-389-8830

Mr. Charles E. Lowe Intec. 21213-B Hawthorne Blvd 5475 Torrance, CA 90509 213-217-5211

Ms. Maria Lucci Naval Air Eng. Center Training Div Code 124 Lakehurst, NJ 08733

Mr. Steven J. Lucks DSD Cad Cam P.O. Box 2507 Pomona, CA 91769 714-868-4540

Mr. Robert R. Lundin IBM 9500 Godwin Dr. 102/072 Manassas, VA 22110 703-367-6914

Mr. Paul R. Lundregan US Gov't Printing Office N Capitol & H St., NW Washington, DC 20401 202-275-2621

Ms. Kathleen Luoma DataServ Inc. 3800 Concord Parkway Suite 500 Chantilly, VA 22021 703-818-1270 Mr. James Lurz VSE Corp 2760 Eisenhower Ave. Alexandria, VA 22314 703-329-2630

Mr. James S. Lutz Harris Corp. 1025 W. NASA Blvd. MS 3A/8154 Melbourne, FL 32919 407-727-5687

Mr. John D. Lycas Logistics Management Inst 6400 Goldsboro Rd. Bethesda, MD 20817 301-320-2000

Mr. Henry F. Lyon Allied-Signal Aerospace Co. MS 3/12, CAE Center Teterboro, NJ 07608 201-393-3596

Mr. L. Lytle Hewlett Packard 3494 East Harmony Rd. Fort Collins, CO 80525

Mr. Frank Mabry Sundstrand Corp. 4747 Harrison Ave. Rockford, IL 61125

Mr. Joe Mabry PVA 22324 E. Golden Springs Dr. Diamond Bar, CA 91765 714-860-1818

Mr. Donald MacEoin EDS 13600 EDS Dr A6N-A48 Herndon, VA 22071 Dr. Bob MacLean Computer Sciences Corp. P. O. Box N Morrestown, NJ 08057

Mr. Robert M. Madigan Pratt & Whitney PO Box 109600 M/L 717-51 West Palm Beach, FL 33410-9600

Mr. Gerald Madvig Crosfield Design Systems 11401 Rupp Dr. Minneapolis, MN 55337

Mr. M.J. Malis Rockwell Int'l 3370 Miroloma Avenue Anaheim, CA 92803 714-762-5501

Mr. Anthony Mamarelli GE Aerospace Building 98 Blue Bell, PA 19422

Mr. John R. Manthe IBM 1301 Piccard Dr. 862/220 Rockville, MD 20850 301-640-5818

Mr. John Maple Jet Propulsion Lab 4800 Oak Grove Dr. 502-317 Pasadena, CA 91109 818-397-7933

Mr. David Markau Naval Air Eng Ctr Training Div Code 124 Lakehurst, NJ 08733 201-323-2423 Ms. Kathleen J. Markham AAI Corp PO Box 126 202/106 Hunt Vailey, MD 21030 301-628-3642

Mr. Wayne Markison SD/ALII P.O. Box 9260 Los Angeles AFB, CA 90009

Mr. Joel Markowitz Grumman M.S. C25/25 Bethpage, NY 11714 516-575-5071

Mr. Charles Marks SD/ALIB P.O. Box 92960 Worldway Postal Los Angeles, CA 90009 213-643-0342

Mr. D. Marler Boeing Computer Services P.O. Box 33126 Philadelphia, PA 19142

Mr. Michael Marraffino GTE Gov't Systems Corp. 77 A St. Bldg 6-8210 Needham Heights, MA 02194 617-455-2854

Ms. Linda N. Marshall IBM 9500 Godwin Dr. 400/046 Manassas, VA 22110 703-367-2628

Mr. William Marsico US Army Logistics Ctr Commander Attn: ATCL-MSC Ft. Lee, VA 23801 804-734-1834 Mr. Chris Martin Embassy of Australia 1601 Massachusetts Avenue NW Washington, DC 20036 202-797-3388

Mr. Pete B. Martinez BD Systems 357 Van Ness Way # 110 Torrance, CA 90501

Mr. Jack C. Matthews General Dynamics PO Box 748 MZ 4040 Ft. Worth, TX 76101 817-935-3222

Mr. P. Mazza U.S. Government PM CALS Attn: ASPES-CA Fort Monmouth, NJ 07703

Mr. John F. McCarthy Int'l Review Long Beach Naval Shipyard 1F4 Long Beach, CA 90822 213-547-8306

Ms. Mary G. McCarthy DTRC Code 1826 Carderock, MD 20084 202-227-3348

Ms. Claire J. McClary General Dynamics 6700 E 14th Mile Rd. Warren, MI 48090 313-978-5463

Mr. Vinnie McCollough Orkand Corp 8484 Georgia Ave. Silver Spring, MD 20910 301-585-8480 Ms. Mary M. McCormick McDonnell-Douglas PO Box 516 Mail Sta. 0642042 St. Louis, MO 63166 314-777-7218

Mr. Jeffrey C. McCray Ferranti International 2345 Crystal Dr. Crystal Pk Fl, S913 Arlington, VA 22202 703-521-3840

Ms. Lorraine McCullough Military Sealift Command Washington Navy Yard M-841M Washington, DC 20398 202-433-7867

Mr. James McDermott Defense Logistics Agency DLA-ZW Cameron Station Alexandria, VA 22304-6100

Mr. John McFadden Software Exoterica 383 Parkdale Ave. Suite 406 Ottawa, Ontario, CN K1Y 4 613-722-1700

Mr. James McGee IBM TJ Watson Res. Ctr. PO Box 218 Yorktown Heights, NY 10598 914-945-1641

Mr. B.B. McGowan Hughes Aircraft Co C5 2009 1600 Forbes Way Long Beach, CA 90305 213-513-3858

Mr. Jack McGrath Philadelphia Electric Co. 2301 Market St MC S8-1 Philadelphia, PA 19101 Mr. Michael McGrath WSIG (A&L) The Pentagon Room 2B322 Washington, DC 20310

Ms. Tracey McGrath AGFA Compugraphic 200 Ballardvale St. 200-3-7K Wilmington, MA 01887 508-658-5600

Mr. John F. McIver Information Handling Sv. 1990 M St., NW Suite 400 Washington, DC 20036 202-331-0961

Ms. Roberta McKinzie TRW 2511 Jefferson Davis Hwy S-1005 Arlington, VA 22202 703-486-3707

Mr. Roy F. McNish EDS 700 E Firmin MS 1203 Kokomo, IN 46902 317-451-2002

Mr. Dave R. McRitchie IBM 6655 Lookout Rd. G621940C Boulder, CO 80301 303-924-0435

Mr. J.R. Meacham Teledyne Systems 19601 Nordhoff Northridge, CA 91324 818-886-2211

Ms. Mary Ann Melosh Aquidneck Data Corp. 170 Enterprise Center Middletown, RI 02884 Mr. Sam Melton HQ, US Army Materiel Com. ATTN: AMCRE-CC 5001 Eisenhower Avenue Alexandria, VA 22333-0001 202-274-9759

Mr. Frank Melvin Defense Logistics Agency 6301 Little River Turnpike Alexandria, VA 22312 AV-284-4210

Mr. Donald Menzies The Aro Corp. 3695 Broadway Buffalo, NY 14227

Ms. Arleigh Meyer CAE-Link Corp 2224 Bay Area Blvd. Houston, TX 77058 713-488-5510

Mr. Mark Meyer Johns Hopkins Univ Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Mr. Stanley Meyers Grumman Data Systems 1000 Woodbury Rd. MS-D31-237 Woodbury, NY 11797

Mr. Bob Middaugh Naval Air Eng. Etr. Code 51222 Lakehurst, NJ 08733

Mr. Charles E. Miller Naval Ordnance Station Code 033E Indian Head, MD 20640 301-743-4878 Mr. V. Minden Interleaf 10 Canal Park Cambridge, MA 02141

Mr. Paul Minnigh NSC T-2137 Ft. George G. Meade, MD 20755 301-859-6003

Mr. Mohammad Mirhakkak Honeywell Federal Sys 7900 Westpark Dr. McLean, VA 22102 703-827-3621

Mr. Sep Mirsepassi Rockwell International 12214 Lakewood Blvd. Downey, CA 90241

Mr. John Mitchell Allied-Signal Aerospace 1300 W. Warner Rd. Mail Stop 1207-3Z Tempe, AZ 85282 602-893-5713

Mr. Travis Mitchell Texas Instruments P.O. Box 869305/8506 Plano, TX 75086 214-575-3523

Mr. John Mittino Defense Prod. Supply Dep. Asst. Sec. The Pentagon, Rm 3E144 Washington, DC 20301 202-697-8177

Ms. Doris Mleczko Navy PAC Missile Test Ctr 0320 Point Mugu, CA 93042 805-989-7183 Mr. Fred Moehle Procurement & Logistics 5202 Leesourg Pike S-1208 Falls Church, VA 22041 703-284-7770

Mr. Jeffrey Mohnkern General Dynamics 260 Overlook Rd. Galstonbury, CT 06033

Mr. Paul D. Mohr Hughes Aircraft Co. 7000 Village Dr. Buena Park, CA 90621 714-670-3657

Mr. John P. Moliere Booz-Allen & Hamilton 4330 East West Hwy N-717 Bethesda, MD 20814 301-951-2167

Mr. Patrick Molluso Grumman Info Conversion 280 Crossways Pk Dr Woodbury, NY 11797 516-682-5203

Mr. James M. Monaco IBM Owego Rt 17C MS 0315 Owego, NY 13827 607-751-5734

Mr. Anthony L. Montiel Optigraphics Corp. 9339 Carroll Park Drive San Diego, CA 92121 619-292-6060

Ms. Lisa C. Montrone US NOTITSC Kendall Sq. NTS-68 Cambridge, MA 02142 617-494-2879 Mr. Jim A. Moore DTRC Code 1822 Bethesda, MD 20084 202-227-1029

Mr. Antonio Morales HQ/AFSC/PLXC Andrews Air Force Base Andrews AFB, DC 20334-5000 301-981-3915

Mr. Charles Moratz GE PO Box 4840 EP 7-21 Syracuse, NY 13221 315-456-0362

Mr. Anthony Mordente Westinghouse Electric Corp. 111 Schilling Road MS 7032 Hunt Valley, MD 21030 301-584-5455

Mr. Kenneth Morgan Intercap Graphics Sys 355 East Main St. Lansdale, PA 19446

Mr. Michael E. Morgan Def Comm Agency 1860 Wiehle Ave. Rm. R137 Reston, VA 22090 703-437-2216

Mr. Robert Morgan DLADCASMA Santa Ana P.O. Box C-12700 Santa Ana, CA 92712 714-836-2761

Mr. Roy S. Morgan NIST Tech A266 Gaithersburg, MD 20899 301-975-3254 Ms. Sharon Morgan Douglas Aircraft Co. 3855 Lakewood Blvd. MC/73-30 Long Beach, CA 90846 213-496-6488

Mr. Dennis Mueller Northrop Corporation 8900 East Washington Blvd. Orgn. L450/3 Pico Rivera, CA 90660 213-948-6111

Mr. Michael N. Muggill USAF Space Sys Div/CNOP P.O. Box 92960 Los Angeles, CA 90009 213-643-1821

Ms. Rhonda Muir Martin Marietta P.O. Box 2009 9103 MS 8160 Oak Ridge, TN 37931

Mr. Stephen P. Murdock CAE-Link Corp 11800 Tech Rd. Suite 206 Silver Spring, MD 20904 301-622-8755

Ms. Candace E. Murray DOT/TSC 55 Bwy, Kendall Sq. DTS-930 Cambridge, MA 02142 617-494-2377

Mr. Daniel M. Murray XEROX 800 Longride Road Stanford, CT 06877 203-968-3418

Ms. Ethel B. Myers The Technigroup Inc. 17320 Redhill Irvine, CA 92714 714-553-0844 Mr. David Myher Naval Aviation Depot Naval Air Station Code 09111 Commn Bldg E69 Norfolk, VA 23511 804-444-8648

Mr. Donald Naify U.S. Air Force CALS MIO HQ AFSC/PLXC Andrews AFB, MD 20334-5000 301-981-3915

Mr. Omey S. Nandyal Microsystems Eng. Corp. 2400 N Hassle Rd. Hoffman Estates, IL 60108 312-882-0111

Mr. Eric Nebergall Access Corporation 1811 Losantiville Avenue Cincinnati, OH 45237

Mr. David J. Nelson Rockwell International, AMSD Mail Code BB72, POBox 4921 3370 Miraloma Ave. Anaheim, CA 92803 714-762-6869

Mr. Paul Nese XEROX 701 S. Aviation Blvd MS A1-18 El Segundo, CA 90245

Ms. Laura M. Neudecker-Parks Tracor Applied Sciences 1601 Research Blvd. 083/Room 9E Rockville, MD 20850 301-279-4583

Mr. Burt Newlin Department of Defense OASD (C) IRM (P&S) Pentagon RM 1C535 Washington, DC 20301 202-697-4890 Mr. Ed Newman Electri-Tech Intern'l Corp. 101 N Alfred St. Alexandria, VA 22314 703-684-5233

Mr. Tin Nguyen Belvoir Res. Dev. & Eng. Ft. Belvoir, VA 22060 703-664-5460

Mr. Joseph P. Nichols Garrett Engine Div 2602 S 47th St. PO Box 5217 Phoenix, AZ 85010 602-731-5246

Mr. Ned Nichols Robins AFB WR-ALC/QL Robins AFB, GA 31098 912-926-0152

Mr. Alan E. Nicoll XEROX Corp. 701 S. Aviation Bivd MS A1-18 El Segundo, CA 90245 213-333-5081

Mr. Robert L. Nieman Venntronix, Inc. 99 Power House Rd. Suite 204 Roslyn Heights, NY 11577 516-625-0455

Ms. Patricia A. Nunn AAI PO Box 126 200/106 Hunt Valley, MD 21030 301-628-3625

Ms. Jane O'Melia Def Qual & Std Ofc 5203 Leesburg Pike Suite 1403 Falls Church, VA 22041 703-756-2554 Mrs. Susan O'Neal Office Secretary of Defense WSIG (A&L) The Pentagon, Rm 2B322 Washington, DC 20301 202-697-0051

Mr. Joseph O'Neil Raytheon Service Co. 2 Wayside Rd. Burlington, MA 01803 617-272-9300

Mr. Michael J. O'Reilly Rosetta Tech, Inc 140 Second Ave. Waltham, MA 02154 617-890-8303

Mr. Ron Oklewicz Apple Computer Inc. 1892 Preston White Dr. Reston, VA 22091

Mr. George Olsen Eldyne, Inc. 4701 Columbus St. Virginia Beach, VA 23462 703-456-0700

Mr. George Oostdyk Defense Proposal Specialist P.O. Box 7865 San Diego, CA 92107 619-225-1266

Mr. Eric Orsini U.S. Army Dep Asst Sec ARMY The Pentagon, Rm 3E620 Washington, DC 20310 202-697-9030

Ms. Janis Osterweil The Aerospace Corporation P.O. Box 92957 MS M8/174 Los Angeles, CA 90009 213-336-3113 Mr. Robert F. Owens Syscon Corp 1000 Thomas Jefferson St. NW Washington, DC 20007

Mr. Anthony Pacala SD/ALIB P.O. Box 92960 World Way Post Los Angeles, CA 90009 213-643-0342

Mr. Alan Paige SRA Corp 2000 15th St., N Arlington, VA 22201 703-558-4700

Ms. Sharon Palmer Nat'l Security Agency 9800 Savage Rd. Ft. Meade, MD 20755 301-688-6871

Mr. Nick Papadopoulos Honeywell Federal Sys 7900 Westpark Dr. McLean, VA 22102 703-827-6422

Mr. Anthony J. Parchinski General Electric Co. 100 Plastics Ave. Rm 43-506 Pittsfield, MA 01201 413-494-5944

Mr. F.A. Paris Guri Sistemas/Finser Corp. 550 Bilmore Way 9th Floor Coral Gables, FL 33134

Mr. Reginald Parker US Army Lab Comm/HDL 2800 Powder Mill Rd. SLCHD-TS-SC Adelphi, MD 20783 202-394-2633 Ms. Heather Park TRW P.O. Box 1310 San Bernardino, CA 92402 714-382-7861

Mr. K.C. Park IBM 2000 Purchase St. Purchase, NY

Mr. Frank Pasquarello US Army 1500 Planning Res Dr Mgt Office McLean, VA 22102

Mr. Mark Patkus Navy/DTRC Code 1826 Bethesda, MD 20084 202-227-3348

Mr. Fred Patten U.S. Navy

Mr. Melvin Patterson Commanding Office Code 75L5:Patterson Keyport, WA 98345 206-396-4200

Mr. Kevin D. Paulson US Government Rock Island Arsenal HQ, AMCCOM/AMCMC MAS Rock Island, IL 61299 309-782-3389

Mr. Dan Pawl Smiths Industries 4141 Eastern Avenue SE Grand Rapids, MI 49518 Ms. Patricia Payne Martin Marietta PO Box 2003 Oak Ridge, TN 37851 615-576-8649

Mr. Mike Pelone GE Aerospace Building 98 Blue Bell, PA 19422

Mr. Ronald M. Penczak Raytheon Service Co. 2 Wayside Rd. Burlington, MA 01803 617-272-9300

Mr. Tom Perea Sandia Nat'l Lab PO Box 5800 Div 2811 Albuquerque, NM 87185 505-844-1627

Mr. Joseph Perez U.S. Army CSDA P.O. Box 1578 St. Louis, MO 63188

Mr. Greg Peters Rock Island Arsenal Rock Island, IL 61299 309-782-5804

Mr. Michael O. Petrea AT&T 2400 Reynolds Rd. Winston-Salem, NC 27106 919-727-6570

Mr. Jack Phelan General Electric M & DSO Bldg. C, Rm. 10C34 P. O. Box 8048 Philadelphia, PA 19101 Mr. Michael L. Philips Advanced Resource Devel. 9151 Rumsey Rd. Columbia, MD 21045 301-997-5600

Mr. James Phillips ARC Prof Sv Group 6295A Edsall Rd. Alexandria, VA 22312 703-823-8481

Mr. James B. Phillips AAI Corp Box 126 210/501 Hunt Valley, MD 21036 301-628-3996

Mr. Roland Piepenbrink Navy Surface Weapon Sys Engineering Station NAVSEA Data Supp Act/5810 Port Hueneme, CA 93043 805-982-3442,3

Mr. Ralph Pierce Ordinance Ctr & School Aberdeen Proving Grd., MD 21005 301-278-5392

Mr. Anthony Pizzo Naval Air Eng Ctr Trng Div Code 124 Lakehurst, NJ 08733 201-323-2423

Mr. Edward Platz US Gov't Printing Office N. Capitol & H St., NW Washington, DC 20401 202-275-8099

Mr. Martin I. Plawsky Grumman Aircraft Systems B05-106 Bethpage, NY 11714 516-577-1473 Mr. Fred J. Pledger AGFA Compugraphic Corp. 4200 Wilson Blvd Suite 500 Arlington, VA 22203 703-558-7700

Mr. Frank W. Podgajny McDonnell-Douglas Co PO Box 516 St. Louis, MO 63166 314-233-7361

Mr. George Pogharian Defense Logistics Agency 6301 Little River Turnpike SLA-2 (DCLSO) Alexandria, VA 22312 284-4210 (AV)

Mr. Alan Polster Bendix Field Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. Lee Poole Accurate Info Systems 3000 Hadley Rd. S. Plainfield, NJ 07080

Mr. Gary Pool Vitro Corp. 14000 Georgia Ave. Silver Spring, MD 20906 301-231-5757

Mr. Bernard L. Poppert Maint. Mgt. & Tech. PO Box 2429 Gaithersburg, MD 20877 301-258-0810

Mr. Don Post Honeywell 1766 Old Meadow Ln. McLean, VA 22102 703-749-2130 Mr. Edwin F. Potter Norden Systems, Inc PO Box 1021 RV 22 Trumbull, CT 06611 203-452-3673

Mr. Richard L. Powell US Army Troop Sup. Comm. 4300 Goodfellow Blvd Attn: AMSTR-MPS St. Louis, MO 63120 314-263-9377

Mr. Peter Prassinos Lawrence Livermore Labs 7000 East Avenue Code L542, P.O. Box 808 Livermore, CA 94550 415-422-4758

Mr. Maurice D. Pratt A.T. Kearny 1299 Ocean Avenue Santa Monica, CA 90401 213-451-3041

Mr. Bill Prewitt SYS 6310 Greenwich Dr. San Diego, CA 92071 619-448-9376

Mr. David Prihar Magnavox 2829 Maricopa St 22M/1 Torrance, CA 90503 213-618-1200

Mr. Samuel Pucciarelli Defense Comm. Agency 8th & S Courthouse R Arlington, VA 22204 703-692-7667

Ms. M. Diane Querry Allied-Signal PO Box 419159 D/878, FB22 Kansas City, MO 64141 816-997-5491 Mr. Herbert Quigley, Jr. Tektronix, Inc. 700 Professional Dr. Gaithersburg, MD 20877 301-590-7571

Mr. Harry Quast Orkand Corp 8484 Georgia Ave. Silver Spring, MD 20910 301-585-8480

Mr. Sam Raimond Bendix Field Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. Cortland Randall Randall Assoc. 307 B Armherst St. #230 Nashua, NH 03063 603-886-5737

Mr. Ronald W. Rau McDonnell Douglas Elect. PO Box 516 E002/107/290/1063303 St. Louis, MO 63166 314-232-7286

Mr. John Reber Motoroia - GEG 8201 E. McDowell Rd. P. O. Box 1417, MD H2274 Scottsdale, AZ 85252 602-949-6766

Mr. James O. Rector Northrop Corp. 500 East Orangethorpe Ave. MS 7623-1Y12 Anaheim, CA 92801 714-441-4258

Ms. Deborah S. Regan Northrop 13020 Yukon Avenue Hawthorne, CA 90250 213-331-4193 Mr. Robert F. Reich McDonnell Douglas Aircraft Co. IMC 77C-2 3855 Lakewood Blvd. Long Beach, CA 90846 714-229-7114

Mr. Paul Reiff Naval Air Eng. Center Training Div Code 124 Lakehurst, NJ 08733

Ms. Carole A. Relick UNISYS 7696 Reston, VA 22091 703-620-7548

Mr. David Remington NSWC Code E-104 10901 New Hampshire Ave. Silver Spring, MD 20903

Mr. Lou Reveron Hewlett Packard 1550 Wilson Blvd. Suite 600 Arlington, VA 22209 703-284-2608

Mr. Jon F. Reynolds 21062 Miramar Lane Huntington Beach, CA 92646 714-960-2265

Mr. Lou Reynolds Hypermedia Research Group 8 Backstay Rd. Jamestown, RI 02835 401-423-1366

Mr. Kerry Richmond McDonnell Douglas P.O. Box 516 MC 1111181 St. Louis, MO 63166 Mr. Shalom A. Rich Agfa Compugraphic 200 Ballardvale Rd. MS 200-3-7K Wilmington, MA 01887 508-658-0200

Mr. Jim Rickabaugh Westinghouse Box 160 Pittsburgh, PA 15230 412-778-5459

Mr. Roscoe T. Riffe US Air Force P. O. Box 92960 SD/ALL Los Angeles, CA 90009 213-643-1810

Mr. James L. Riordan Marine Corps 1300 Wilson Blvd. PSL-P Washington, DC 20380 202-697-2603

Ms. Susan Roberge McDonnell Douglas 11071 Grant Way Stanton, CA 90680 213-496-7445

Mr. Bruce A. Roberts Aerojet Electrosystems 1100 W. Hollywood Azusa, CA 91702 818-812-1631

Mr. Thomas H. Roberts Lockheed Electronics LSH1 Plainfield, NJ 07061 201-757-1600

Mr. James A. Rodear Delco Electronics 700 E Firmin St. HOF-M Kokomo, IN 46904 317-451-4247 Mr. Dennis Rogosen Air Force ASD 4FL Wright Patterson AFB, OH 45433

Mr. Anthony Romeo Grumman Aircraft Systems MS 805-106 Bethpage, NY 11714

Mr. J. Rosenberg Info Tech. Center Carnegie Mellon Pittsburgh, PA 15213

Mr. Bud Rosman Naval Air Engineering Ctr. Training Div Code 124 Lakehurst, NJ 08733

Mr. Bradley Ross GE Aerospace MS/23A30 P. O. Box 8048 Philadelphia, PA 19101 215-531-7743

Mr. Fredrick Rossi Concept Devel. Tech. 27 Cambridge St. St. 104 Burlington, MA 01803 617-272-1290

Mr. Christian Roux DCAN/TOULON CAPCA STE Les Oursinieres 83220 Le Pradet, FRANCE

Ms. Kathryn Roy Interleaf 10 Canal Park Cambridge, MA 02141 £17-577-9800 Mr. Richard N. Rubenstein IBM 9500 Godwin Dr. 876/E2K Manassas, VA 22110 703-367-2376

Mr. Yuri I. Rubinsky Soft Quad, Inc. 720 Spadina Ave. Toronto, Ontario, CN 17552 416-963-8337

Mr. Simon Rudis US Army Central Systems 210 N Tucker Blvd St. Louis, MO 63188 314-263-5741

Mr. Art Rulon US Army AMC MRSA Attn: AMXMD-MP Lexington, KY 40502 606-293-3415

Mr. Dale Rupp 3M Company Bldg 220-10W-01 St. Paul, MN 55144 612-733-1462

Mr. Steve Rusinko Logis-Tech 1800 Diagonal Rd. Suite 250 Alexandria, VA 22314 703-684-7117

Mr. Donald R. Saari Innovative Technology Inc. 7927 Jones Branch Dr. McLean, VA 22102 703-734-3000

Mr. Michael Sadagorsky NPPSO 700 Robbins Avenue Philadelphia, PA 19111 Mr. Peter M. Salisbury Naval Sea Sys Comm PMS 409 Washington, DC 20362 202-746-0070

Mr. Frank Sambuco Boeing Computer Services P.O. Box 33126 Philadelphia, PA 19142

Mr. Chuck Sanders U.S. Navy Space & Naval Warfare Syscom SPAWAR 003-1 Washington, DC 20630

Mr. Ruben Sanders Harris Corp. P.O. Box 37 M.S. 15/8741 Melbourne, FL 32902 407-729-2211

Mr. Felix A. Santos Martin Marietta K-25, Hwy 58 Bldg K-1037, MS 346 Oak Ridge, TN 37922 615-575-5212

Mr. Tom T. Sapp Marine Corps 1300 Wilson Blvd. PSL-P Washington, DC 20380 202-694-1630

Mr. V. Sauers P. O. Box 367 White Sands Missile Range, NM 88002

Mr. Joseph Saunders U.S. Army Project Manager CALS Attn: AS-PES-CA-T, MS 1B-408 Fort Monmouth, NJ 07703 Ms. Terry R. Savage TRW 200 Ocean Gate Suite 1200 Long Beach, CA 90802

Mr. Donald M. Savitt Rockwell Int'l 6633 Canoga Avenue/Rocketdyne Canoga Park, CA 91303 818-700-3719

Mr. Doug Sayles Atomic Energy of Canada Sheridan Park Res. Community Mississauga, Ontario, CN L5K 1 416-823-9040

Mr. George Scarborough McDonnell Douglas Astronautics P. O. Box 516 Dept. E501/598/2/224 St. Louis, MO 63166 314-925-4448

Mr. Charles W. Schade Allison Transmission/GM PO Box 894 M-29A Indianapolis, IN 46206 317-242-6559

Mr. T.D. Schaeffer Rockwell Int'l 3370 Miraloma Avenue Anaheim, CA 92803 714-762-7967

Mr. Robert W. Schaffran Navy/DTRC Bethesda, MD 20084

Mr. Stewart M. Schiffman DuPont PO Box 6099 Eagle Run Plant Newark, DE 19702 302-733-9271 Mr. Tom Schock Booz-Allen & Hamilton 4330 East-West Hwy. Bethesda, MD 20814 301-951-2446

Mr. Douglas Schroeder General Dynamics Systems W251422 P.O. Box 80508 San Diego, CA 92138 619-753-3847

Mr. Ronald L. Schuldt Martin Marietta Box 179-Ms DC-0380 Denver, CO 80201 303-971-9581

Mr. Peter Schultz GSA Irms 525 Market St 9KTN San Francisco, CA 94105

Mr. Donald L. Schurman SAIC 101 S Park Ave. PO Box 50697 Idaho Falls, ID 83405 208-529-2611

Mr. Karl Schwach Dataserv Inc. Volt 3800 Concorde Parkway Chantilly, VA 22021

Ms. Karen D. Schwartz Gov't Computer News 8601 Georgia Ave. Rm 300 Silver Spring, MD 20910 301-650-2136

Mr. Norman Schweitzer Prime 2067 Linda Flora Dr. Los Angeles, CA 90077 213-476-4838 Mr. Bryant A. Scott Northrop Corp. 8900 E. Washington Blvd L591-IS Pico Rivera, CA 90660 213-948-8371

Mr. Frank Scott Kruse Industries Inc. P.O. Box 245 Downingtown, PA 19335

Mr. Glenn Scott NSC T-2132 Ft. George G. Meade, MD 20755 301-859-6061

Ms. Brenda Scruggs Defense Logistics Agency DLA-SCT Room 4D592 Cameron Station Alexandria, VA 23304-6100 703-274-6793

Mr. Lucas K. Seamons XEROX Corp ESAE-118 701 S. Aviation Blvd El Segundo, CA 90245 213-333-7844

Mr. William Seeger Contel - Fed. Systems 12015 Lee Jackson Hwy Fairfax, VA 22033 703-359-7924

Ms. Cecile Seguin Lockheed P.O. Box 551 Burbank, CA 91520

Mr. Darr Sell Nat'l Security Agency 9800 Savage Rd. Ft. Meade, MD 20755 301-688-6871 Mr. Gerard P. Shabe Martin Marietta Aerospace 103 Chesapeake Park Plaza Baltimore, MD 21220 301-682-1631

Mr. William Sharkey DASD(L&MM) The Pentagon Rm. 2C263 Washington, DC 20301

Mr. Dennis Shaw Naval Ordinance Station Code 063 Bldg 69 Louisville, KY 40214

Mr. Juan Shealayno'sun PM CALS ATTN AS-PES-CA Ft. Monmouth, NJ 07703 201-544-2058

Mr. E. J. Shepherd General Dynamics Corp Eastern Point Rd. Groton, CT 06340 203-446-5997

Mr. Russell Shorey ADASD(S) The Pentagon, Rm 2B322 Washington, DC 20301-8000 202-697-0051

Ms. Joyce Shriver Allison Gas Turbine/GM Co 1911 N. Ft Myer Dr. Suite 800 Arlington, VA 22209 703-284-1714

Ms. Annette Shuford DTRC Code 1826 Bethesda, MD 20084 202-227-3348 Mr. Ric Sias AGFA Compugraphic 200 Ballardvale Street Wilmington, MA 01887 508-658-5600

Mr. Forrest Siburt Grumman Data Systems 6838 McLean Prov. Ci Falls Church, VA 22043 703-760-0130

Ms. Sheryl Sieracki Arinc, Inc. 2551 Riva Rd. Annapolis, MD 21401 301-266-4642

Mr. Tony Sievers Sievers & Associates 405 Greer Pl. Herndon, VA 22070 703-471-4562

Mr. Jason Silvia Prime Computer Inc. Prime Park Nadick, MA 01760

Dr. Walter Simonson Defense Logistics Agency Cameron Station MS-DLA-Z (DCLSO) Alexandria, VA 22304

Mr. Donald R. Singer Advanced Tech., Inc. 2121 Crystal Dr. Suite 200 Arlington, VA 22202 703-769-3000

Mr. Harry E. Sinsheimer USAF ALI II5 Los Angeles AFB El Segundo, CA 90066 213-643-0142 Mr. Jerry P. Skelton Planning Research Corp. 600 W Service Rd. Washington, DC 20041 703-883-5017

Mr. William H. Skewis Eagle Tech., Inc. 2300 S Ninth St. Arlington, VA 22204 703-979-8300

Mr. Jack Sleith Computer Sciences Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Mr. John R. Slocum IBM Owego Rt. 15 Bodle Hill Rd. Owego, NY 14623 607-751-3592

Mr. Richard Smeyer Xerox 1800 Diagonal Rd. Suite 300 Alexandria, VA 22314 703-836-1823

Mr. Billy J. Smith Vitro Corp. 13332 Ridge Lane Silverdale, WA 98383

Mr. Bob Smith NEC Systems Laboratory 1414 Massachusetts Avenue Boxborough, MA 01719 508-263-2627

Mr. Douglas A. Smith General Dynamics P. O. Box 80508 MZ/W2-5144 San Diego, CA 92129 619-573-3857 Mr. Fred J. Smith Martin Marietta Energy Box 2003, MS 7191 Bldg K-10001 Oak Ridge, TN 37831

Mr. James E. Smith PRC 1500 Planning Res Dr Rm. 353 McLean, VA 22102 703-556-1525

Mr. John Smith CAE-Link Corp. 2224 Bay Area Blvd. Houston, TX 77058 713-488-5510

Mr. Nick Smith Honeywell 600 2nd St., NE MN11-2842 Hopkins, MN 55343 612-931-5389

Ms. Suzanne Smith Aerojet Electro Systems 1100 West Hollyvale St. P. O. Box 296 Azusa, CA 91702 818-812-1000

Ms. Tres Smith US Geological Survey 12201 Sunrise Valley MS 904 Reston, VA 22092 703-648-6085

Mr. Dennis W. Smolak SofTech, Inc. 5285 Dunleigh Dr. Burke, VA 22015 703-764-2179

Mr. Ed E. Snuggs Texas Instruments 8505 Forest Ln. MS/ 3193 Dallas, TX 75266 214-480-2612 Mr. Skip Snyder E.I. Dupont 7617 Cervantes Ct. Springfield, VA 22153 703-569-2908

Mr. Clarence Spinner Westinghouse 111 Schilling Rd. MS 7037 Hunt Valley, MD 21057 301-584-3697

Ms. Di-Ann Spolidoro General Dynamics Valley Sys. P.O. Box 50-800 MS 602-51 Ontario, CN 91761 714-945-8595

Ms. Jill Stahl General Dynamics P.O. Box 85990 DC-8940 San Diego, CA 92138 619-496-7231

Mr. Allen J. Standish Anadac, Inc. 1735 Jefferson Davis Hwy Suite 300 Arlington, VA 22202 703-486-7129

Mr. Ronald F. Steinberg Allied Signal Aerospace 1300 E Joppa Rd. Dept 463 Baltimore, MD 21204 301-583-4384

Ms. Marie V. Stella Mitre Corp. 1820 Colshire Blvd. W422 McLean, VA 703-883-5764

Mr. Robert Stengl GE - Aircraft Engines 111 Merchant St Rm 340 Springdale, OH 45246 Ms. Melinda A. Stetina UNISYS 12010 Sunrise Valley 7696 Reston, VA 22091 703-620-7903

Ms. Kathy Stewart CAD/CIM Alert 824 Boylston St. Chestnut Hill, MA 02167

Ms. Marilyn Stewart NPPSO Philadelphia 700 Robbins Avenue Philadelphia, PA 19111

Mr. Robert Stewart Computer Sciences Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Ms. Patricia A. Stich Dynamic Systems 625 Slaters Ln. Suite 100 Alexandria, VA 22314 703-684-2991

Mr. John Stidd Xerox 475 Oakmead Parkway MS 405 Sunnyvale, CA 94086 408-737-4338

Mr. Richard Stieglitz RGS Associates 2011 Crystal Dr. Suite 205 Arlington, VA 22202 703-769-5852

Mr. James R. Stivson Contel Federal Sys 12015 Lee Jackson Hwy Fairfax, VA 22033 703-359-0276 Mr. Bryan Stolle Sherpa Corp 611 River Oaks Pkwy San Jose, CA 95134 408-433-0455

Mr. David A. Stoltz Automated Scanning 3303 Harbor Street C-12 Costa Mesa, CA 92626 714-432-1253

Mr. Harold B. Stormfeltz Northrop Aircraft 1 Northrop Ave. Dept. 8802, MZ 76 Hawthorne, CA 90250

Mr. Cary Stout General Dynamics 50-2.5 P.O. Box 2507 Pomona, CA 91769 714-868-4931

Mr. Richard Stover GTX Corp. 8836 N 23rd Avenue Phoenix, AZ 85021

Mr. James E. Strang Allied-Signal Aerospace 2525 W 190th St. T-52 Torrance, CA 90509

Ms. Lorinda K. Stringer D. Appleton Co. 3028 Javier Rd. Suite 300 Fairfax, VA 22031 703-573-7644

Mr. Allen Stroup TAMSCO 4041 Powder Mill Rd. Calverton, MD 20705 301-595-0710 Mr. Raymond Sudduth Nat'l Security Agency 9800 Savage Rd. Ft. Meade, MD 20755 301-688-6871

Mr. Ken Sulek Advanced Tech., Inc. 2121 Crystal Dr. Suite 200 Arlington, VA 22202 703-769-3000

Ms. Carole Sullivan Ziff-Davis 80 Blanchard Rd. Burlington, MA 01803 617-273-5500

Mr. John H. Sullivan Innovative Tech 7927 Jones Branch Dr McLean, VA 22102 703-734-3000

Mr. William Susie Westinghouse 5121 Kenwood Baltimore, MD 21206

Mr. Karl Suthard Defense Tech. Info. Cntr. Cameron Station Alexandria, VA 22304 703-274-7661

Mrs. Judith Suttenberg UNISYS Lakeville Rd & Marcu 1A-18 Great Neck, NY 11791 516-574-2348

Mr. David Swanson U.S. Army AMC CSDA 210 N. Tucker St. Louis, MO 63188 Mr. Gregory Swedberg The Aerospace Corp. P.O. Box 92957 MS M4-913 Los Angeles, CA 90009

Mr. William Sweet The MT Company 2494 Route 547 Lakehurst, NJ 08733 201-657-5600

Mr. Wayne Swindel LASC D 6352 2 419 86 Cobb Drive L 10 Marietta, GA 30063 404-494-6367

Mr. Arthur H. Swisher US Army 1500 Planning Research Jt. Tact. Fusion Office McLean, VA 22020 703-556-2925

Mr. William Sylvester NAVSEA CP5 Room 600 2211 Jefferson Davis Hwy Washington, DC 22022 692-3086

Mr. Chester Szymczak US Gov't Printing Office N. Capitol & H St., NW Washington, DC 20401 202-275-2619

Mr. Philip Tabor Naval Underwater Sys Ctr Code 81, Bldg 990 Newport, RI 02841 401-841-2098

Mr. Pexford Talbert Defense Tech. Info. Cntr. Cameron Station Alexandria, VA 22304 703-274-7661 Ms. Oliva Tanguay Oerlikon 225 Seminaire Blvd S St. Jean, Quebec, CN J3B8E 514-358-2000

Mr. Carmine C. Tarantino AlL Systems 28 Fairway Dr. Hauppauge, NY 11778 516-243-7418

Mr. Charles Tarleton USAF SM ALC/XPS McClellan AFB, CA 95652

Mr. Mat A. Tavares Raytheon Service Co. 2 Wayside Rd. Burlington, MA 01803 617-272-9300

Mr. Don B. Taylor Allied-Signal 3520 W Westmoor St. South Bend, IN 46624 219-231-2275

Ms. Kimberly K. Tencer W Virginia Univ 415 Knapp Hall Box 4031 Morgantown, WV 26506 304-293-2431

Mr. Darrell Thomas Infoscore P.O. Box 3359 San Dimas, CA 91773 714-592-5001

Mr. David Thomas SYS 6310 Greenwich Dr. Suite 200 San Dlego, CA 92122 619-587-0484 Mr. David Thomas Gov't Printing Office N Capitol & H St. NW Washington, DC 20401 202-275-2881

Mr. John C. Thomas DOD 9800 Savage Rd. T21 Ft. Meade, MD 20755 301-859-6066

Mr. Walter E. Thomas Newport News Shipbuilding 4101 Washington Ave. Bldg 520, 4th Fl Newport News, VA 23607 804-688-8179

Mr. John M. Thompson Tech Mgmt Corp 2121 Eisenhower Ave. 6th Fl Alexandria, VA 22314 703-684-3055

Ms. Maryanne Thompson TRW 1 Federal Syst. Park MS W1/1510 Fairfax, VA 22033

Mr. Ray M. Thompson Rockwell 3200 E Renner Rd. MS 454-180 Richardson, TX 75080 214-705-1957

Mr. Richard Thompson Innovative Tech., Inc. 7927 Jones Branch Way Suite 500 McLean, VA 22102 703-734-3000

Mr. Ernest D. Thorne Def Qual Std Ofc 7407 Foxleigh Way Alexandria, VA 22310 703-756-2554 Mr. Fremont R. Tittle Control Data 2970 Presidential Dr Suite 200 Fairborn, OH 45342 513-427-6389

Dr. James Tomlinson Army Communications Command PM-CALS Ft. Monmouth, NJ 07703 201-532-0400

Mr. E.B. Tompkins Johns Hopkins Univ Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Ms. Colette M. Toolsie FAI 5 Choke Cherry Rd. Suite 180 Rockville, MD 20850 301-258-5130

Mr. Lou Toth Hughes Aircraft Bldg. AO1 MS4C620 P.O. Box 9399 Long Beach, CA 90810 213-513-3123

Mr. Ronald Treusdell US Army Material Command AMCRE-C 5001 Eisenhower Avenue Alexandria, VA 22333-0001 202-274-5703

Mr. Robert Trimble Naval Weapons Ctr. Code 36641 China Lake, CA 93555 619-939-3441

Mr. Raiph P. Troop Computer Science Corp 3160-B Fairview Pk D M/C 211 Falls Church, VA 22042 703-641-2569 Mr. Susmi Tsutsumi CACI 1735 Jefferson Davis Hwy Suite 100 Arlington, VA 22202 703-553-4927

Ms. Joanne Ulmer Arinc, Inc. 2551 Riva Rd. Annapolis, MD 21401 301-266-4642

Mr. Fred Unger E.I. Dupont 7617 Cervantes Ct. Springfield, VA 22153 703-569-2908

Mr. Tommie Usdin CBIS/Snider Engineering 8133 Leesburg Pike Suite 250 Vienna, VA 22091 703-556-0720

Mr. Richard Van Sciver AT&T I-85 & Hope Church Road C3B23 McLeansville, NC 27301 919-279-3010

Mr. Charles W. Van Winkle IBM 6705 Rockledge Dr. Bethesda, MD 20817 301-564-7639

Mr. Chris Vance General Electric P.O. Box 8048 Philadelphia, PA 19101

Mr. Lloyd E. Vancil Naval Ship Weapons Eng Sta. 901 W. Olive Street Oxnard, CA 93033 Ms. Beth Vandemark Innovative Technology Inc. 7927 Jones Branch Dr. McLean, VA 22102 703-734-3000

Mrs. Sherryl L. Veach Digital Equipment Corp 18301 Prof. Pl. DCO-226 Landover, MD 20785 301-306-2236

Mr. Bob Ventimiglia GE 1285 Boston Ave. Bldg 29EE Bridgeport, CT 06601 203-382-2696

Mr. David E. Verbarg Dynamic Controls 8 Nutmeg Rd. S S. Windsor, CT 06074 203-528-9971

Mr. Donald L. Vickers LLNL P.O. Box 808, L-542 Livermore, CA 94550 415-422-4231

Ms. Terri Vineyard Martin Marietta Energy Box 2003 MS7191 Bldg K-10001 Oak Ridge, TN 37831

Mr. Danny Vint General Dynamics 2438 34th Street San Diego, CA 92104 619-694-7230

Mr. George Vleck General Dynamics Space Sys D P.O. Box 85990 MZ C2-8920 San Diego, CA 92138 Ms. Maria Voight General Dynamics 10900 E 4th Rancho Cucamonga, CA 91730 714-945-8784

Mr. Eric Von Dollen WESCO 1901 Olympic Blvd Walnut Creek, CA 94596 415-930-7700

Ms. Virginia P. Von Gal EDS 3700 Industry Avenue Lakewood, CA 90714 213-595-4756

Ms. Florence Vyrn UNISYS 12010 Sunrise Valley 7421 Reston, VA 22091 703-620-7147

Mr. Phillip Wackym Interstate Electronics 604 Vermont D/4620 Anaheim, CA 92803 714-758-2651

Mr. James Wager Business Consultant 1060 Carolan 116 Burlingame, CA 94010

Mr. C.F. Waite General Dynamics MZ W2-5651 5001 Kearny Villa Rd. San Diego, CA 92138 619-573-3646

Dr. Shukri Wakid NIST Bldg 220/B254 Gaithersburg, MD 20899 301-975-2904 Mr. Eric Walberer Loral Defense Sys. Div. Arizona MS/2621 P. O. Box 85 Litch Field Park, AZ 85340 602-925-7671

Mr. Steve Walker U.S. Air Force HQ AFSC/PL AC Andrews AFB, MD 20603

Mr. John F. Wallace IBM 1301 Piccard Dr. 862/210 Rockville, MD 20850 301-640-6001

Mr. Michael Walsh The Orkand Corp 8484 Georgia Ave. Silver Spring, MD 20910 301-585-8480

Ms. Maryann Wangemann EDS 13600 EDS Dr. A6N-A48 Herndon, VA 22071

Mr. Michael Ward Naval Air Sys Comm 1421 Jefferson Davis Hwy 180/JP2 Arlington, VA 20361 703-692-5661

Ms. Rebecca Ward Cadcentre Inc. 10700 Richmond Avenue 143 Houston, TX 77042

Mr. Ronald Ward Nat'l Security Agency 9800 Savige Rd. Ft. Meade, MD 20755 301-688-6871 Mr. Ed Warnshuis AGFA 200 Ballardvale Wilmington, MA 01845

Mr. John F. Washburn IBM 1301 Piccard Dr. 862/220 Rockville, MD 20850

Ms. April Waskey Bendix Field Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. Calvin Wassmuth
Pratt & Whitney
P.O. Box 109600
MS 732-24
West Palm Beach, FL 33410

Mr. John E. Wasson E Systems, Inc PO Box 1056, CBN90 Greenville, TX 75401 214-457-6480

Mr. John B. Waston Santa Barbara Research Ctr 75 Coronar Dr Bldg B31/125 Goleta, CA 93117 805-562-4952

Mr. Mike E. Watson Emerson Electric 8100 West Florissant St. Louis, MO 63033 314-553-1254

Mr. Don W. Weber RGS Assoc., Inc. 20111 Crystal Dr. Crystal Park One Arlington, VA 22202 703-769-5850 Mr. Roy C. Weber SSD ALIS Los Angeles AFB Los Angeles, CA 90009 213-643-2611

Lt. Col. Douglas W. Webster Consolidated Space OCPO HQ SD/CWC P. O. Box 92960 Los Angeles, CA 90009

Mr. Gerald B. Webster McDonnell Douglas Helicopter Bldg. 543/D214 5000 East McDowell Road Mesa, AZ 85205 602-891-3305

Mr. Bob Weeks Hughes Aircraft A202 3970 Sherman Street San Diego, CA 92110 619-543-4097

Mr. Marv Weinman IBM 1301 Piccard Dr. 862/220 Rockville, MD 20850 301-640-5864

Ms. Noreen Welch Computer Science Corp. 4600 Powder Mill Rd. Beltsville, MD 20705 301-937-0760

Ms. Debbie Wells UNISYS PO Box 64525 St. Paul, MN 55164

Ms. Valerie W. Wert Evaluation Research Corp. 1725 Jefferson Davis Hwy Suite 300 Arlington, VA 22202 703-979-8220 Ms. Lori Westbrook Navy/DTRC Code 1826 Bethesda, MD 20084 202-227-3348

Mr. G.W. Westley Martin Marietta PO Box 2004 Oak Ridge, TN 37831

Mr. Roger West Johns Hopkins Univ Johns Hopkins Rd. Laurel, MD 20707 301-953-5000

Mr. Bill White Defense Logistics Agency DLA-ZS Cameron Station Alexandria, VA 22304

Mr. Mark White Bendix Field Eng. Corp. 1 Bendix Rd. Columbia, MD 21045 301-964-7713

Mr. Robert White McDonnell Douglas PO Box 516 MS/0642042 St. Louis, MO 63166 314-777-7205

Mr. Tom White ISI 13101 Washington Blvd Los Angeles, CA 90066

Mr. Kendall E. Whitfield Westinghouse Electric Corp. 111 Schilling Road Hunt Valley, MD 21030 301-584-5455 Mr. John Whittaker DLA Mgmt. Support Office 6301 Little River Turnpike Beauregard Square #310 Alexandria, VA 22312 703-274-4210

Mr. Daniel Wick Mentor Graphics 8500 S.W. Creekside Place Beaverton, OR 97005 503-626-7000 x2986

Mr. Dave Wiedeman PEMA 100 Chautauqua Rd. Arnold, MD 21012 301-261-2885

Mr. Robert J. Wielatz OSD/DASD (L) 1518 B Carlswell Cir Bolling AFB, DC 20336 202-697-5530

Ms. Doreen L. Wiggins Douglas Aircraft Co. 3855 Lakewood Blvd Long Beach, CA 90846 714-229-7482

Ms. Sharon Wigglesworth USAF P.O. Box 92960 SSD/CLHL Los Angeles, CA 90009 213-336-4629

Ms. Jean Wiley Defense Logistics Agency DLA-SEP Cameron Station Alexandria, VA 22034

Mr. James P. Wilkinson Smiths Industries 7-11 Vreeland Rd. Florham Park, NJ 07932 Mr. Richard Wilk Eaton Corp. Commack Rd. Deer Park, NY 11729 516-595-6904

Mr. Roland Willey UTC-Hamilton Std Div One Hamilton Rd. 1-2-B13 Windsor Locks, CT 06096 203-654-3562

Mr. G.W. William Naval Sea Combat 835 Philpotts Rd. Norfolk, VA 23513 804-444-9240

Mr. David Williams Williams International/MS11-19 2280 West Maple P.O. BOX 200 Wallde Lake, MI 48088 313-624-5200

Mr. Warren Willis The Technigroup Inc. 17320 Redhill Suite 250 Irvine, CA 92714 714-557-0844

Col. Edward Wills PM CALS AS-PES-CA Hexagon Rm 1B408 Ft. Monmouth, NJ 07703 201-532-0400

Ms. Susan A. Wills Xerox Rt 7 & 659 E102-4AD Leesburg, VA 22075 703-729-8000

Mr. Jeffrey P. Winbourne Sigma Plus, Inc 4001 Williamsburg Ct Fairfax, VA 22302 703-591-0733 Mr. James H. Windham U.S. Army St. Louis, MO 63020

Mr. Charles Wingfield Def Qual Std Ofc 5203 Leesburg Pike Suite 1403 Falls Church, VA 22041 703-756-2340

Mr. Robert J. Winklareth Analytic Sciences Corp 1700 N Moore St. Suite 1800 Arlington, VA 22209 703-558-3856

Mr. John T. Winters, Sr. Def Qual Std Ofc 5203 Leesburg Pike Suite 1403 Falls Church, VA 22041 703-756-2554

Mr. Richard Wismer IDX Corp. 21515 Ridgetop Circle Sterling, VA 22170

Mr. J. Robin Wohnsigl Control Data Corp 3101 E 80th St. Minneapolis, MN 55440 612-853-3316

Mr. James Wolowicz AMP Inc. P.O. Box 3608 MS 106-10 Harrisburg, PA 17105

Mr. James Wood General Dynamics P.O. Box 85357 MZ/C6-2640 San Diego, CA 92138 619-694-7230 Mr. Jonathan Wood Institute for Defense Anal. 1801 N Beauregard St CSED/Skyline Alexandria, VA 22311 703-845-3590

Mr. James B. Woods Hughes Aircraft Co. P. O. Box 9399 C DPC07 2043 Long Beach, CA 90810 213-616-9022

Mr. M.N. Woods Douglas Aircraft Co. 3855 Lakewood Blvd MS/2-56 Long Beach, CA 90846 213-593-2174

Mr. Mark W. Woods John Hopkins Univ. Johns Hopkins Rd. 1W131 Laurel, MD 20707 301-792-5109

Mr. Edward Woody Defense Intelligence Attn: RDT-2 Washington, DC 20340 202-373-3240

Mr. Ed Worsham GSA 8443 Rushing Creek C Springfield, VA 22153 703-557-1930

Mr. Jesse Worthington Martin Marietta Energy Box 2003, MS 7191 Bldg K-10001 Oak Ridge, TN 37831

Dr. Haviland Wright Avalanche Development 947 Walnut St. Boulder, CO 80302 303-449-5032 Ms. Sheree Yang Ford Aerospace Company Bldg. 5-K Ford Road Newport Beach, CA 92658 714-720-6259

Mr. Ronald E. Yanko IBM Rt. 17c M/D 0315 Owego, NY 13827 607-751-5918

Mr. John Yankoviak Defense Logistics Agency DLA-.: 6301 Little River Turnpike Alexandria, VA 22312

Ms. Michele Yeager ILC Dover P.O. Box 266 Frederica, DE 19946

Mr. Joseph M. Youmans Hughes Aircraft Co. 164 Nieto Avenue Long Beach, CA 90803 213-616-3478

Mr. Joe Young Electronic Data Systems 13600 EDS Dr. A6N-A48 Herndon, VA 22071

Mr. Jerry Zadow Agfa Compugraphic 200 Ballardvale St. MS 200-3-7K Wilmington, MA 01887 508-658-5600

Mr. Karl Zauner HQ/AFSC/PLXC Andrews AFB, MD 20334 301-981-3915 Mr. Gary Zavadil Rockwell Int'l 12214 Lakewood Blvd Downey, CA 90241 213-922-4044

Mr. Jose Zayas-Aguiar Electronic Data Systems 13600 EDS Dr. 6N-A48 Herndon, VA 22071

Mr. Harry Zimmerman U.S. Navy Naval Facilities Eng. Command 200 Stovall Street Alexandria, VA 22332-2300 Attn: 04

Ms. Maria S. Zmurkewycz AMSAA IRO 800 Custom House Philadelphia, PA 19106